JUL 16 1923

TELEPHONE ENGINEER

VOLUME 27 JULY, 1923 Number 7

Standard Equipment

Those telephone operating managers who know Strowger Automatic through actual use almost invariably come to recognize it as standard equipment, and refuse to consider any other type for future replacements. This is not because of any engineering necessity but because of the better service rendered and the greater profit realized.

The time is soon coming when automatic equipment will be the *standard* equipment for the entire telephone industry. Let us help you to *prepare* for that time now,—whether you are ready to *act* now or not.

Automatic Electric Company

FACTORY AND GENERAL OFFICES: CHICAGO, ILLINOIS

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ASSOCIATED COMPANIES

INTERNATIONAL TELEPHONE SALES AND ENGINEERING CORPORATION, New York

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No. 43
DESK STAND

MAGNETO OR COMMON BATTERY

Test of service puts this instrument in first place

Sturdy Construction, Simplicity of Mechanism, and Electrical Correctness Spells Economy and Dependability. Standard apparatus is employed throughout making this instrument practically unexcelled for efficiency in service.

Secure satisfied Subscribers by installing THESE "QUALITY" TELEPHONES.

Prices and detailed information furnished on full line of SWITCHBOARD and TELEPHONE equipment.

WIRELESS

We are prepared to supply

HEAD RECEIVERS, MICROPHONES, KEYS, JACKS, PLUGS, ETC.

American Electric Company

CHICAGO, U. S. A.

A stock of our standard equipment is carried in stock by a distributor in your territory

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INTERSTATE COMMERCE COMMISSION CONTROL

The action of the Board of Directors of the United States Independent Telephone Association in asking that the Interstate Commerce Commission modify its requirements as to reports and accounting of Class B, C and D telephone companies should meet with the hearty approval of the industry. There has been growing within the industry a feeling that the conditions which made regulation in these matters desirable a few years ago, no longer exist and that the time has come when some relief from the burden should be given.

One who has not gone through the process of preparing the dozen or more reports that are required annually from even the smaller companies, can not realize the burden thus imposed. It is true that the information requested is along the same lines in many of the reports, but the form is different and each report requires a considerable amount of work. Among the smaller companies, where the manager is bookkeeper, collector and contract agent in addition to his other duties as repairman, lineman and traffic supervisor, an entirely disproportionate amount of his time is required for report making.

With the exception of a very few "state line" companies, the majority of the Class B, C and D companies merely supply terminals for interstate traffic. Less than 20 percent of the revenue of the business, as a whole, is from interstate messages and, in the case of the companies in the classes mentioned, it is probably less than five percent. Furthermore, most of the State Commissions now require accounting in accordance with Interstate Commerce Commission requirements, a condition which did not exist when the telephone companies first came under the control of that Commission.

It appears that the law gives the Interstate Commerce Commission a large amount of discretion in the matter of what it will require in the way of accounting and reports and, therefore, it is at liberty to take such action as it may deem proper. It is to be hoped that the Commission will find it practicable to grant the request now made in the interest of the smaller telephone companies.

BUY MATERIALS NOW!

Recent declines in prices of lead and copper with accompanying drop in cable prices suggest that now might be a good time to contract for late-year requirements of construction materials.

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NINE O'CLOCK PAY STATIONS

Have you ever had the experience of finding yourself in a strange city and being unable to locate a pay-station when you wanted to make a long-distance call? It seems that a large number of cities which have good telephone service in other respects are "nine o'clock towns" in the matter of public pay stations. If you do not believe it, try to find a pay-station after that hour. How much revenue is lost because of inconvenient pay-station location no one can estimate, but such loss of revenue is waste, just as reckless spending is waste. A few pay stations, located in places which are easily accessible to the general public, will pay a handsome return on the investment.

SELECTING THE MAN FOR THE JOB

At this time of year, with the construction program going at full speed, the force has been built up to its maximum number of men. Within a couple of months, as work approaches completion, some men will be laid off, or at least no more will be hired to replace those who quit.

Most of the new employees that have been added to the force have been employed by the foreman, superintendent or manager and put to work at whatever job was at hand. Too often, they have been started in with only the most meagre instructions and have been allowed to pick up the work as best they could.

While there has been some effort made to pick the man for the job, many times the necessities of the occasion require that all avail-

able men be used. Frequently men are employed as ground men who have neither the physique nor the disposition ultimately to become good linemen. Likewise, men with no aptitude for work on delicate apparatus are put to work on equipment. Men fitted for office work are placed in the plant, and vice versa.

Many of the men who now are on the force will become permanent employees. They will be needed for replacements and additions to the force. The selection of the men who are to be retained usually is left until the time comes when it is necessary to lay off some of them, or often is left entirely to chance. A man is retained if he does not quit voluntarily, regardless of his fitness for the work he is on.

There is no reason why this process of selection should not commence immediately. By this time, the foremen have become well enough acquainted with the new men to have formed fairly accurate judgment of their characteristics. Men who obviously are in the wrong place may be transferred to other departments where they can apply themselves to better advantage, or where they will find the work more congenial. By such transfers, judiciously made, the men may find the work to which they are best adapted; also, their experience will be broadened by contact with different departments of the business. Moreover, when the time comes for the selection for a permanent position, the management will have the assurance that the best man available is placed in the job.

REMEMBER: THERE ARE OTHERS

In these torrid days of July and August when the entire office force from the manager to the office boy are thinking of the joys of vacation, either to come or just gone by, let's stop a moment for a thought of sympathy for the man in the construction gang. Maybe he'd like to go fishing, too.

FINISHING THE JOB

In a certain town, on a certain telephone pole is a wood bracket. Just an ordinary oak bracket of the same kind as thousands and thousands of others; it is nailed to much the same kind of pole, with the same kind of spikes. Unlike these thousands and thousands of brackets, however, this one is doing no useful work. No insulator is screwed firmly down on its threads. It supports no wire over which messages of business or social import may find their path. It serves no useful purpose and neither does it add anything to the beauty of the earth.

It is true that once this bracket was doing its share just as the multitude of other brackets are doing today. This was before the cable came to do the work of the aerial wires. A few years ago we happened to come along just as the last of the wire was removed from this lead. We saw a lineman on this very pole cutting down the wires and later we saw him remove the old cross arms. When he came down, the bracket still remained.

"A very simple thing," you say, "the lineman forgot to knock off the bracket." True, but as we have passed this pole from time to time, that bracket has taken on a symbolic meaning to us. It stands for an unfinished job; for work that has never been quite completed. Just a moment or two more while the lineman was on the pole and it could have been taken off. Now it will remain until the pole itself is removed.

At times we have paused to think about some of our own jobs that have old brackets left on them. We are in a hurry as other matters press and sometimes the temptation is very great to neglect a few minor details that go to make a finished job. We have yielded at times and whenever we have done so we have lost something. We have lost the priceless satisfaction that comes from knowing that we have done a good job and have completed it in every detail.

THE PROBLEM OF THE SMALL EXCHANGE

One of the unsolved problems of the telephone business is the question of what is to become of the very small exchange—say 200 stations or less. Hundreds of such exchanges have been built and are in operation, giving service after a fashion. It is the exceptional thing, however, to find one that is in good physical condition and which is giving service of the quality demanded by modern practice.

As long as the traffic is purely local, the bad conditions in some of these small exchanges do not affect the general telephone service, but when a subscriber on a poorly maintained small exchange is connected to a toll line, it is a matter of concern to the long distance company and to distant exchanges. Many calls are lost and often overtime charges are cancelled because of poor transmission, due solely to terminal conditions in such an exchange.

Where larger companies own such exchanges, they have sometimes followed the policy of putting the plant into fairly good condition and caring for the maintenance from a larger center. The operating may be arranged by contract, thus relieving the company of much supervision. If the books still show red, the deficit is absorbed in the operation of the property as a whole.

Where the property is owned by a local stock company, the problem is more difficult. Such an exchange can not carry the burden of expense of a full-time lineman, in addition to the operating wages, at the rate schedules usually in force in exchanges of this size. Funds are not available for improvements and replacements and the plant gradually deteriorates.

If the company has the mutual form of organization we have the old story of everybody's business and nobody's business. Ultimate rebuilding with a heavy assess-

ment on the stockholders seems to be the only hope.

There are many exchanges of small size owned and operated by private individuals that have done fairly well and are giving pretty good service. Many telephone men prefer the owning of their own business in a small community to working for larger companies on salary. Doubtless there are others working on salary who would be glad to own a small exchange if they could finance its purchase. One of the possible ways of solving the problem of operating the small exchange might be the plan of placing such a man in the exchange, with an arrangement whereby he would become owner on a payment basis similar to that used by building and loan associations and now being suggested for smaller telephone companies. An ambitious man, with the incentive of ownership, could make a success when any other form of operation would be a failure.

THE TOLL REVENUE BAROMETER

Telephone toll revenues constitute one of the most reliable barometers of general business conditions. The Interstate Commerce Commission report of Operating Statistics of Class A Companies for the first three months of 1923 shows an increase of 18.1 percent over the corresponding period of 1922, thus showing in definite figures the generally satisfactory business conditions which prevail in the larger centers. Traffic continues to be heavy on the long distance lines, indicating a continuation of business activity for a considerable period in the future.

ARE YOUR RATES ADEQUATE?

There is no doubt that many telephone companies are operating, at the present time, on an inadequate schedule of rates. Some of them did not receive sufficient relief when past increases were granted, while others, having failed to make application until general price levels began to fall, then found that the public was in no frame of mind to consider higher rates.

The attitude of the public and of regulating bodies is most favorable to rate adjustment during times when the community affected is relatively prosperous. We are in the midst of such a time in the industrial communities of the country and companies operating in such communities that can justify an increased schedule of rates should not overlook this opportunity.

About Telephone Men

Chauncey C. Baldwin, for more than twenty years connected with the Standard Underground Cable Co. at Perth Amboy, N. J., died at his residence there June 7, 1923, aged 57. He had been one of the outstanding figures in the copper rolling and wire-drawing industry for many years, his connection with the Standard Underground Cable Co. dating from 1902. In 1916 he was elected a vice-president of the company, which position he held at the time of his death.

He took an active part in local affairs and for some years had been president of Perth Amboy Industrial Association; also a director of the First National Bank of Perth Amboy and other local interests.

George H. Hawley has been appointed manager of the metal departments of the Standard Underground Cable Co.'s Perth Amboy (N. J.) Works, to fill the vacancy caused by the death of Mr. Baldwin. Mr. Hawley has been production manager for the past three years of the departments in question, and had an unusually wide experience in such work before going with the Standard.

FOR SALE—Erickson No. 1-C, 51-B, 53-B, 56-B, 57-B, and 54-A relays at $1.50 each. Address: Corwin Electric Co., Lafayette, Indiana.

"Cut Insurance Rates" Call at Wisconsin Meeting

La Crosse, Wis.—Telephone companies are paying unduly large insurance premiums, and reductions in this item are imperative, decided the midsummer meeting of the Wisconsin State Telephone Assn., held at La Crosse June 29 and 30. The association instituted a movement for enlisting the co-operation of all telephone associations in a concerted effort to reduce fire, general liability and compensation insurance rates. Organization of a mutual insurance company was considered. Fire losses paid to telephone companies amounted to 15 per cent of the premiums paid and 50 per cent to other businesses, according to figures presented to the meeting. F. B. MacKinnon, president of the National Independent Assn., told the meeting he would co-operate in enlisting the other State associations in the insurance-saving effort. Other developments of the meeting were consideration of a plan for identifying the owner or owners of each of the 200,000 telephone poles in the State and the promotion of safety first work. A telephone operators' school was conducted by Miss Anne Barnes of Des Moines in connection with the meeting.

Switchboard Plugs from Denmark

Telefon Fabrik Automatic, Amaliegade 7, Copenhagen, Denmark, are anxious that every telephone man become acquainted with the merits of their patented switchboard plug. A letter to the company, mentioning TELEPHONE ENGINEER, will bring descriptive catalogue and a sample conductor plug with section of same, showing method of insulation. They claim their type of plug is superior both as regards electrical stability and mechanical strength. This means not only an economic plug, but obviates the necessity of frequently having to change faulty plugs on the switchboard. The profiling of the plug is done by means which insure absolute precision. The tolerance worked to is .03 mm., equivalent to .0012". Telefon Fabrik Automatic has been established for more than thirty years, and has made plugs by this special method for the last eleven years. Owing to the unsettled state of the world during the greater part of this period, they have been prevented from introducing these plugs in a number of countries. However, it now is being recognized by telephone engineers in our country as possessing technical and economic advantages.

LINE AND DESK

A TRANSMISSION PROBLEM

The following transmission problem has been proposed for discussion in Line and Desk: "We are planning to put up a copper metallic circuit between our main exchange and two smaller exchanges. Both will be bridged on the line. One is 18 miles and the other 27 miles away. At the present time we have a No. 12 iron metallic and believe the copper circuit would give better service both to our main office and to other points switched through there. How much improvement would be made?"

It is assumed that a No. 10 B&S ga. copper circuit is being considered. The transmission over 27 miles of such a circuit, excluding cable losses at the exchanges and loss in exchange apparatus, would be approximately equivalent to 2.1 miles of standard No. 19 ga. cable. The transmission over the No. 12 iron circuit, if it is in good condition, would be between eight and one-half and nine miles of standard cable. The improvement would then be equivalent to about six and one-half miles of standard cable. This would be a noticeable improvement in transmission between the exchanges located at the ends of the line.

In case the line is conected to another line at one exchange, probably the best way of expressing improvement would be by comparison of distance. A gain of 6.5 miles of standard cable is approximately equal to 80 miles of No. 10 B&S ga. open wire. In other words, it would be possible to talk over a toll circuit 80 miles longer with the copper circuit than with the iron circuit. It might be said that the copper circuit would increase the toll radius of the exchange at its end by about 80 miles and still maintain the present grade of transmission.

One point usually overlooked in transmission, is that the transmission from the intermediate exchange on the toll line will be approximately the same as that from the exchange at the end. The effect of the wire beyond the intermediate exchange upon transmission is practically the same as if the wire were included in the circuit over which the conversation is being carried on.—Staff Contribution.

MIKE WAS TOO PARTICULAR

The other day, Bill, a new employe who had been assigned as a helper with Mike, who runs the installation wagon, came into the manager's office on some other business. In the course of the conversation the manager asked him how he was getting along in his new work.

"I like the work fine," said Bill, "but I think Mike is too particular about it."

"How is that?" asked the manager.

"Well, we were putting in a telephone yesterday," said Bill, "and I got a little dirt on the floors. Mike made me borrow a mop from the lady of the house and mop them up."

"So you think Mike was too particular," said the manager. "What do you suppose the lady thought?"

"I suppose she thought it looked funny to see me mopping up her floor."

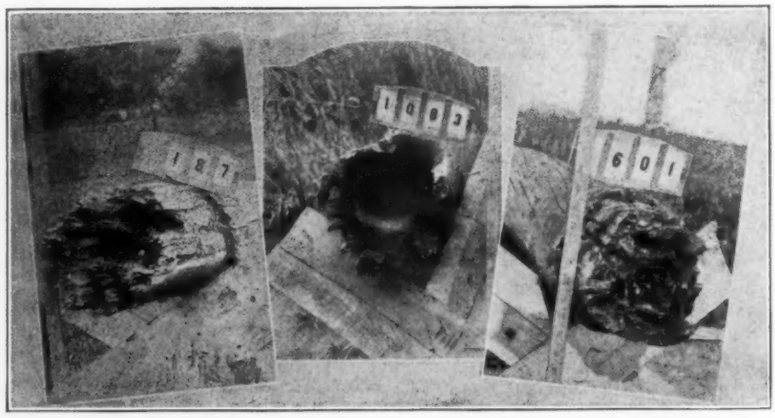
"I don't think she did," said the manager. "I believe she was thinking that, if the telephone company has people who are careful in cleaning up after making an installation, it also has people who are particular enough to see that she gets good service in other ways. I think Mike has the right idea. Mike's plan made that woman a friend of the telephone company from the very beginning."—Contributed by W. H. VanHorn.

FIBRE STRENGTH OF CEDAR DOES NOT CHANGE WITH AGE

Over eighty poles, varying in age from ten to twenty-two years, were broken off in the lines of the Northwestern Bell Telephone Co. in Iowa to test the validity of the engineering theory that there is very little change in the unit strength of cedar timber on account of age, as long as it remains sound. The results of the investigation are given by L. F. Holmes, Iowa Division Toll Line Engineer, in the "Northwestern Bell Magazine."

A rope was attached near the top of the pole to be broken. The pole was then pulled over by snatch blocks, anchored to another near-by pole. A dynamometer inserted between the snatch blocks and the pulling rope gave the pull required to break the pole. When the pole was no longer able to withstand the strain, it broke with a snap and the dynamometer showed the pull in pounds.

At each pole broken, a picture was taken and a section was sawed off to be sent to the laboratories where the breaking strength and the unit fibre strength in pounds per square inch were determined. The results are shown in the following table:



When poles are broken, their interiors are sometimes found to look like this

Years in service	*Number of poles completely tested*	*Average unit fiber strength per square in.*
22	11	4,303
20	4	3,854
16	6	3,185
15	2	3,492
14	3	3,583
13	3	3,532
10	4	4,150

A strength of 3,600 pounds per square inch long has been accepted as standard for the average strength of Eastern white cedar.

"These tests called my attention very forcibly to the fact that the strength of a pole can not be accurately estimated by its appearance above the ground line," says Mr. Holmes. "One pole with an exceptionally large circumference broke while the slack was being taken out of the snatch blocks and before any reading could be obtained on the dynamometer, while another pole with a very small circumference refused to break; the butt of the pole cutting out of the ground.. . . . . It appears that the replacement of a pole should not be determined by its age, but by the amount of sound wood at its weakest point, which is generally at or near the ground line."

BROADCASTING RESUSCITATION INSTRUCTIONS

Overlooking no medium for gaining the widest possible dissemination of instruction in the prone pressure method of resuscitation from electric shock, the Accident Prevention Committee of the National Electric Light Association has requested all major radio broadcasting stations in the country to include in their programs brief talks outlining the mechanics of the method and its importance to human safety. Practically all of the stations have agreed to send out the message, or have actually done so. The instructions prepared by the committee and transmitted to the broadcasting stations are as follows:

"The American Gas Association, the National Electric Light Association and the National Safety Council have requested ——— to transmit the following information on 'Resuscitation':

"Many persons meet death every year by drowning, by poisonous fumes or by electric shock, when a few simple measures would have saved their lives.

"The victims are seldom killed outright, and only need to have their breathing restored artificially.

"Listen closely and we will tell you how to produce artificial respiration, and we will repeat the instructions so that you will be sure to get them:

"Start treatment immediately, and as near the scene of the accident as possible.

"Lay victim on stomach—face to one side—arms extended straight forward.

"Now kneel—straddling victim—well below the waist—facing toward his head.

"Place your hands on small of victim's back, just above hips and touching lowest ribs.

"With arms straight, swing forward slowly—bring your weight to bear upon the victim—gradually but not violently—for about three seconds.

"Then swing back to original position, releasing your weight.

"Repeat operation about twelve times a minute, or at the rate you yourself breathe.

"All you do in these instructions is to force air out of the lungs when you exert pressure, and when you release pressure the air flows back itself.

"The victim will usually show signs of returning life within a half hour, but, if not, continue as long as four hours.

"Do not move him until he is breathing normally without assistance, then use a stretcher, keeping him warm and in bed for several hours.

"Learn this method yourself. Delays are fatal. Do not leave the patient until breathing is restored. Death is the frequent result of efforts to send for help. If you have mastered this method of artificial respiration you have in your own power the best means of reviving the patient. Try it on your friend and have him try it on you now."—National Electric Light Association Bulletin.

ACCIDENT PREVENTION HINT

There is many a slip twixt the ground and the top—of a pole covered with advertising posters.

RARE CASE OF TROUBLE

Repairman, after getting his flivver out of the garage one morning, calls into the wire chief's desk for his first assignment. The desk reads off something like this: "Number 3042W at 300 S. Park street, reports C. R. C. O. line tested open outside last night on voltmeter test, but tests O. K. now." Now, if there is anything which will inspire a trouble shooter to extend himself beyond the elastic limit it is a "come and go" trouble, because he knows that such troubles are the seeds from which may later grow the "written complaint."

Arriving at his destination, his first thought is to look over the drop wire from the ground to see if, for instance, some contractor had opened the drop wire in the course of his work and had, with kindly intent, hand spliced it together; such hand splices while now nearly extinct in our plant still are occasionally encountered, and have the strange and peculiar habit of going "open" or "noisy" at times.

After satisfying himself that the wire looks all right (although looks are often deceiving) he goes up to the door and rings the bell.

The subscriber answers the bell and states that it is "all right now; he just used it," but the trouble man explains that there is an intermittent trouble affecting this line, which if not cleared, will occasion further, and perhaps frequent, annoyance. Repairman first lifts the receiver and asks the operator to "please leave the cord in a few minutes" and listens with his experienced ear for the loose connection noise which so often accompanies an intermittent open and which is often of great assistance in its location. No luck, the line sounds as quiet as an empty church.

To digress for a moment: As all repairmen know, the cause of intermittent opens and also of most reported noises on telephone lines is two conducting surfaces somewhere in the series path of the current which are only lightly touching each other, or which are corroded or coated with oxides, sulphides, or rosin. These may be at any of a thousand and one places, but to illustrate their nature a fuse ribbon broken within the fuse tube but still touching, or a wire broken under a milonite nail (within, perhaps, uninjured insulation) but still touching, will serve. Happily, such obscure troubles have one or both of two principal electrical characteristics which assist in their localization. First, such a case will nearly always have considerable potential drop across the "loose joint" if current is flowing. Second, commonly such a joint if mechanically disturbed while carrying current will act as a transmitter. Also very commonly, such cases emit a sound normally, which to the experienced ear is recognized as a "loose connection" sound, this sound usually being much greater or existing only when the current is flowing around the loop in one direction and being less or disappearing when the current is reversed. This characteristic assists the test operators to detect and recognize many of these cases.

Now, to proceed with the trouble in hand: Troubleman tapped the bell box with his screwdriver handle while listening in the receiver, and shook the instrument and cords before leaving the set, but all failed to evidence trouble. He left the receiver off and as no splices were visible in the inside wiring, next listened with his test receiver across the line and across all possible loose joints at the protector which also received its share of the tapping act but failed to disclose trouble. The next test was made at the party line "tap," which is made with a pair of little brass "nut"-like affairs, and the next at the cable terminal from which the drop worked, including tapping the terminal

and shaking drop wiring. Still no luck.

While up at the terminal the only two splices in the line, which were fortunately close to the pole, were untapped for inspection, the sleeves appeared to be of proper size for the wire and twisted the proper number of turns, and by listening across each sleeve (with receiver still off at the station) one at a time, absence of potential drop indicated them to be sound. After taping them up he descended and went to the FX box where the aerial cable connects to the underground and made similar further tests without detecting trouble.

The line had now been given a good "once over" without finding trouble, yet there remained the simple, irrefutable evidence that with no cable or other rearrangement work going on the subscriber had reported "Can't Raise Central Office" and that the night man had found the line open outside of the office on voltmeter test.

There now remained two principal possibilities: One, a loosely twisted cable conductor joint in some splice of the aerial or underground; the other, a ruptured wire within possibly uninjured insulation in some part of the drop wire not under strain, or in the inside wire at the house.

Repairman decided that the latter should be looked for first, so he took a coil of inside twisted pair from his trusty flivver, which still stood by, and connected one end of this coil to his head receiver terminals and the other to the line wires at the subscriber's instrument. Donning the head receiver, he was now prepared to hunt the trouble within a cruising radius of some hundred feet.

Starting at the bell box and moving the ice chest and similar sundries from the path of hostilities, he faithfully followed the wire, lightly tapping it every foot or so, and tapping milonite nails and cleats until he reached the protector. Still no luck. On he went, following the outside line on the house from fastening to fastening assisted by his ladder, and then, after one knob was passed, the glorious sound was heard. Every time he tapped the line he heard it in the receiver. The sought was found. By fingering the wire, he finally found the precise spot from which sounds could be made, cut out about a foot of the defective wire and spliced in a new piece. He had evidence to satisfy the doubts of any skeptic soul that he was "some trouble shooter." The trophy, when split open at the point of trouble, showed a diagonal welded factory splice which had broken apart within perfect insulation.—"The Transmitter," Baltimore, Md.

BUGS WE HAVE SHOT

A few days ago, when I was alone at the exchange, a line went in trouble with a ground. In order to be able to get a test from the office, in case I needed it, I very carefully instructed one of the operators how to operate the voltmeter test set. I then rattled out along the line in the old Ford until I found what I thought was the trouble. After clearing it, I called for a test anyway, and was surprised to be told that the voltmeter still read 24 volts when the test was made. Finally I told the young lady to leave the test set just as it was when she made the test and went back to the office. When I got back, I found out why the voltmeter read 24 volts. The operator, very conscientiously, had been reading the position of the movable indicating hand instead of the voltmeter needle which rested quietly at zero.—Contributed.

Note This: They Thanked Him

At Ottumwa, Iowa, during Courtesy Week, Foreman Mart Munley, of the Northwestern Bell Co., and his construction crew were out in the country stringing wires. The majority of the crew had gone on ahead, leaving a small group to tie in the wires.

As the plant men traveled down the road they had thrown out into the grass a couple of glass insulators for each pole. A farmer who was driving along thought that the insulators had been lost out of a wagon and accordingly began to pick them up. When he caught up with the advance crew, he presented the collection.

Not to be outdone—for it was Courtesy Week—the plant men gratefully thanked the farmer for his service. Then as soon as he was out of sight they traveled back along the road and re-scattered the insulators.

China's Telephone Workshop

W. P. Strickland, of the International Western Electric Co., just returned from China, reports that the Orientals are expanding and improving their telephone system as rapidly as possible. Seven new telephone exchanges recently have been completed at Nanking, Shanghai, Soochow, Wusih and Peking. A toll line now is under consideration between Shanghai, Nankin, Hankow, Tientsin and Peking. "This expansion of China's telephone system made necessary a factory at Shanghai for the manufacture of the apparatus," continues Mr. Strickland, formerly superintendent of this plant. "The China Electric Co. was organized by the International Western Electric Co. and the Chinese Minister of Communications in 1918. In 1919 work was started in the new plant at Shanghai, which now employes 450 Chinese workers, making telegraph instruments, telephone sets, special telephones and switchboards for military purposes, central office switchboards and other apparatus. While this work is of a technical nature, the Chinese are very adaptable to such work, being not only deft, but extremely patient and easily contented. Such a thing as a labor problem is rare in China.

The largest contract completed by this Chinese factory was the Hatamen.

Chinese workmen making up telephone switchboard cables. Insert: The cables connect the jacks and lamps in front of these Chinese operators

Radio Rebroadcasting Plan

Wired Wireless at Radio Frequencies Eliminates Need of Spare Cables and Allows Almost Unlimited Reception Range—Outlines a Practical System for Rebroadcasting

By J. B. RATHBUN

In the April issue of TELEPHONE ENGINEER I outlined some possible methods of rebroadcasting radio reception via the wired wireless method, which was followed in the June issue by a description of some exceedingly practical and interesting applications by J. A. Gustafson of Fredonia, Kansas, the latter being entirely dissimilar to the ideas advanced in April. From present indications it would seem that interest in rebroadcasting is rapidly increasing among telephone men, and that the time will soon come when the exchanges will be able to supply dual service to their subscribers.

My pet scheme has been to rebroadcast the various concerts, lectures, etc., on the lines at radio frequency, thus gaining certain features of flexibility and selectivity not possible when the rebroadcasts are made at audio frequency. Mr. Gustafson holds to the diametrically opposite idea, and in his practical working out of the system employs purely telephonic methods of distributing at audio frequency, spare cable pairs being used for connection between the amplifiers at the exchange and the loud speakers located in the homes and stores of the subscribers. This stands for simplicity and avoids much preliminary experimental work, but according to my light, it does not afford the listener sufficient variety of reception, and furthermore, cannot be used universally in portions of the city where cable pairs are lacking.

Transmitting over the wires at radio frequency has the dual advantages of not requiring spare cables and of an almost unlimited range of reception from the various stations at the will of the individual subscriber. In other words, he is free to pick out any program in which he may be interested, without compelling others on the same line to listen to his selections. Further, the signals transmitted at radio frequency do not interfere with the telephonic messages transmitted in the same wire at audio frequency, hence special isolate cable pairs are not necessary for the distribution of re-broadcasts. By proper radio frequency amplification at the exchange, signals from distant stations which are ordinarily too faint for detection by any but the most powerful receivers can easily be detected by the simplest of radio apparatus when connected to the line.

In further explanation of the radio frequency system of distribution it is necessary to use an untuned receiver

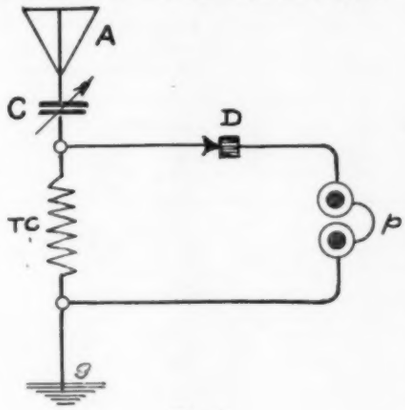


Fig. 1

at the exchange which is capable of picking up every wave length from 200 to 20,000 meters, and then amplifying this hodge-podge of wave lengths for transmission on the line. Selectivity at the exchange is not desirable, since a tuned circuit at this point means that the subscribers are compelled to take what the exchange may offer them. Selectivity is the function of the individual line receiver located on the

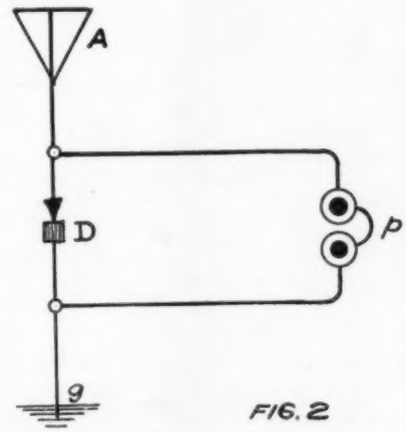


FIG. 2

premises of the subscriber, this local apparatus being so designed that any particular wave length may be picked out at random and without reference to the choice of the exchange or of other listeners on the line. For the subscriber to be limited to the broadcasts of the usual mediocre local talent would in the long run prove something of a bore, to say the least, and this I believe thwarts the whole purpose of re-broadcasting.

Tuned and Untuned Reception.

The recent action of the Department of Commerce in allocating different wave lengths to the various broadcasting stations has resulted in a great range of wavelengths, thus reducing interference between the various stations and making it easier to tune in, than formerly was the case. By varying the capacitance and inductance of the receiving circuit any one of these wavelengths can be selected with comparative ease by ordinary apparatus to the complete exclusion of all other stations operating on different wavelengths. A circuit so arranged with a variable capacitance, inductance or both is called a "tuned circuit" and is by far the most commonly employed today, for obvious reasons. An "untuned" circuit is one in which no variation of the capacitance or inductance is possible, hence such a circuit will respond to any wavelengths that will come within the limits of its circuit constants.

Fig. 1 shows a simple tuned circuit, in which (A) is the aerial, (C) is a variable condenser, (TC) is either a fixed or variable inductance, (D) is some form of detector, and (p) are the phones. Adjustment of the circuit inductance is performed by varying the capacity of the condenser (C) until the circuit is in response with the particular wavelengths or frequency desired. The coil (TC) offers an infinite impedance to waves of the desired frequency, throwing them through the detector circuit shunted around (TC) while waves of different frequency pass through (TC) to ground (g). In other words, the tuning elements (C) and (TC) act like a sieve in retaining the desired waves, while the others pass through the "mesh" of the inductance to ground. This is only one of many such possible combinations, but is chosen here for its simplicity.

Fig. 2 shows an untuned circuit in which the waves intersected by the aerial (A) pass directly through the

detector (D) and phones (p) on their way to ground, hence the frequency of the currents received is limited only by the natural capacity and inductance of the circuit itself. By listening in at the phones (p) one can hear everything that is being transmitted at that time ranging from amateur code at 200 meters to the Arlington time signals. This receives a jumble of superposed signals that is practically unintelligible when the traffic is heavy.

By the use of an untuned receiving aerial connected to a line, and by connecting a number of tuned circuits

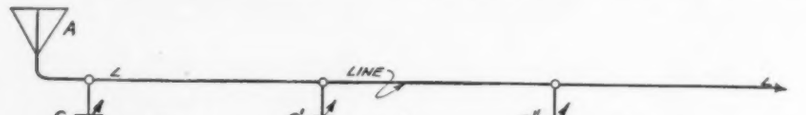


FIG. 3

or stations connected with this line we can select any broadcast on any desired wave length at any of the stations. In Fig. 3 is a simplified diagram in which the untuned aerial (A) supplies the line (L) with currents of varied frequency. For simplicity only the elementary tuned circuits are shown at the stations (1-2-3), but it is assumed that sufficient energy enters the aerial to operate the three sets. By various adjustments of the condensers (C'-C'-C') at the various stations each station can receive on a different wavelength independently. As shown, (1) is receiving on 200 meters, (2) on 360 meters, and (3) on 600 meters, all of them working different stations. Distribution is of course at radio frequency.

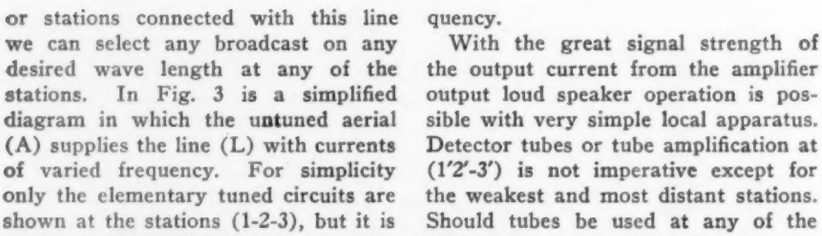


FIG. 4

Since this simple arrangement would not be sufficient for the reception of long distance broadcasts with the elementary receivers shown, some means of amplifying the aerial currents at radio frequency must be adopted as shown by Fig. 4. Here we have an untuned circuit supplied by the aerial (A), the tubes (1-2-3) being arranged for radio frequency amplification as shown. The amplified output of the tubes at (0-0) is fed to the lines (L-L') to which the simple receivers (1'-2'-3') are connected. All of the wavelengths received by (A) are amplified, and the selection of any wave-length or broadcast is entirely under the control of the various stations. Both the amplified radio frequency current and transmission audio frequency telephone transmission can take place simultaneously on the lines (L-L') without interference, a thing impossible were both systems of audio frequency.

With the great signal strength of the output current from the amplifier output loud speaker operation is possible with very simple local apparatus. Detector tubes or tube amplification at (1'2'-3') is not imperative except for the weakest and most distant stations. Should tubes be used at any of the stations, then care must be taken to guard against irradiation or primary regeneration at these points for irradiation at any of the stations would seriously interfere with the reception of the remaining stations.

It should be born in mind that the amplifier circuit shown is purely schematic in character and that the choice of any particular hookup at this point would be determined largely by experiment. It might be that the last tubes in the amplifier would give better results with the plate circuits connected in parallel rather than in cascade as shown in the diagram, and it would be likely that parallel operation would be more suitable for long lines or lines on which a great number of stations were located.

The elementary station circuits shown in Fig. 3 are of the single circuit type and are not particularly selective. In the actual working out of the scheme it is very likely that a two circuit or loosely coupled circuit would be necessary for the proper degree of selectivity. The amplifier at the exchange is really a booster of weak radio impulses making possible the use of simple and inexpensive receivers on long distance reception. The efficiency of such a means, properly worked out in detail, is proved by the many "haul-ins" affected by powerful receivers grounded to common grounds with crystal receivers. The writer has repeatedly received stations from 800 to 1,000 miles distant on a simple crystal set when grounded to the same water pipe with a three tube regenerative set. In this case the "line" conductor consisting of the water pipe was not even insulated from the ground and the extremely small potential existing on the grounded pipe was sufficient to haul in stations far too distant for direct reception with the crystal receiver alone.

New Telephone Companies

Rio Grande Valley Telephone Co., of McAllen, Tex., has been incorporated with capital stock of $75,000. Incorporators: W. E. Delong, W. D. Frisby and Lucile C. Frisby.

The Midway Telephone Co., of Midway, Woodford county, Ky., has been incorporated with $6,000 capital stock. The incorporators are W. A. McKenney, F. M. McKenney and G. T. McKenney.

At Dinuba, Calif., the General Grant Park Telephone Co. has been organized with a capital of $50,000, divided into 1,000 shares of $50 par value each.

At Iola, Kan., the Neosho Valley Telephone Co. has been organized with a capital of $500.

At Rush Center, Kan., the Rush Center Telephone Co. has been organized with $5,000 capital.

At Rush, Ky., H. J. Ross, C. Bolt and W. Rife have incorporated the Bottsfork Telephone Co. with $2,000 capital.

At Orangeville, O., C. A. Hobart, R. F. Pruden, E. C. Boyd, J. H. Case and E. U. Hyde have organized the Jefferson & Warren Telephone Co. The capital is $10,000.

At Portland, Tenn., application for a charter has been filed by the Buntin Farm Mutual Telephone Lines. W. E. Freedle, M. Caudill, N. E. Armstrong, D. Potts and R. Harris are incorporators.

Storage Battery Upkeep

"Prevention First" Is the Slogan Suggested by Battery Inspector for Maintenance of Telephone Storage Batteries—Abstract of Address Before Indianapolis - Lafayette Section, A. I. E. E.

By D. D. Sandefur

One of the great factors in the telephone field and one that has been the means of its rapid growth is the storage battery. In the years of 1860 when Gaston Plante dipped two strips of lead into a dilute solution of sulphuric acid and sent a current of electricity through them he produced a secondary or storage battery. On this foundation the present efficient storage battery is constructed.

Through the service of the storage battery it has been made possible for the telephone system to serve its millions of telephone stations continuously twenty-four hours a day.

I do not believe the public generally realize the enormous amount of capital invested in this one branch of the service. As an example: About one year ago when the automatic and manual systems were merged in this city (Indianapolis) to serve the public better and increase the capacity for future growth, it was necessary to install a larger battery plant. This was done at a cost of approximately $40,000. When it is taken into consideration that this represents only one out of the twenty-five individual storage battery plants necessary to serve the 72,000 subscriber stations in this city and suburbs, and, besides these the numerous other smaller storage battery plants serving private branch exchanges in railroad offices, various institutions, department stores, hotels, government buildings, banks and large offices, it will be seen that the investment in this item is very large.

To give the utmost efficiency we must give the storage batteries special care and attention. Like any piece of apparatus, such as an ammeter, if the bearings are not properly oiled trouble soon begins, or your automobile—if you should neglect to keep plenty of oil in your engine, you know the results; so with the storage battery; if it is not carefully guarded it will be low in efficiency and short in life.

There are several "diseases" that materially affect a storage battery and if allowed to creep in soon bring destruction. I am a firm believer in the old adage "that an ounce of prevention is worth a pound of cure." Following up this old adage we should inaugurate a "Prevention First Measure." Some of the diseases that a storage battery is subject to may be enumerated as follows:

Loss of capacity, corrosion of plates, fracture and buckling, shedding of active material, sulphation, reversal of negative plates, hardening of negative in air and poor ventilation.

Loss of capacity is usually traced to an over discharge and allowing the sulphate to harden on the plates. When this disease is manifest a normal condition is brought about, if the trouble is not of too long standing, by two or three prolonged overcharges.

Fracture and buckling are due to excessive or unequal expansion of the plates due to over discharge. An excessive amount of shedding or the collection of a large amount of sediment in the cells is due largely to excessive charging.

When I see a battery that has been treated in this manner I am inclined to believe we regard it as a large water tank equipped with an overflow, so that if we pump more water into this tank than is required to fill it no injury is done, as the overflow is the safety valve. This is far from being the case with a storage battery; the energy is not stored in the cells but a condition is brought about by a chemical action, so that when a battery is charged it is one in which the active material of the positive plates is lead peroxide and that of the negative plates is sponge lead. On discharge these conditions are reversed and a portion of the active material on each plate has been converted into lead sulphate. The electric current when flowing through the cells in the direction of charge has the function of a chemical reduction or oxidizing agent. When passing in the direction of discharge the current given out is produced by the energy of chemical action, so it behooves us to practice the prevention-first methods to prevent this unusual amount of shedding of the active material, by following strictly the rules in charging, for, if the current is allowed to flow longer than the time required for the chemical change, shedding will follow.

Reversal of negative plates occurs when a cell shows low capacity and when it reaches zero the strength of the stronger cells in the battery forces the current through the cell in a reversed direction. The best remedy in this case is an individual charge in order to bring back its normal condition.

In speaking of the injurious effects of poor ventilation, I had occasion to inspect a battery that was placed in a cabinet, this cabinet was poorly ventilated and the acid spray was not carried away. In about eighteen months, under this treatment the battery was in a condition for repairs. A battery of the same type and size but in a well ventilated room has been performing its daily service for eight years, and is in good condition. Another cause of rapid deterioration is to allow the height of the electrolyte to reach a level below the tops of the plates. A cell that was thus treated shed the active material of the positive plates so completely as to leave only the frame.

Another item which covers the installation of a new storage battery is the initial charge. It is important that this charge is complete in every respect for this charge greatly determines the life of the battery.

In recent years cadmium testing for troubles in storage batteries has been carried on with good results. After one becomes familiar with its use it is also valuable in determining the charged condition of the plates. The maintenance of the voltage and consequently the capacity of the battery depends on both the positive and negative plates and therefore if one be fully charged or fully reduced, and the other only imperfectly charged the capacity is small, being equal only to that of the least efficient plates. It is necessary that both the positive and negative elements be fully charged. The voltage of the battery is not always an indication of the state of charge and in order to determine the condition of the two plates it is necessary to test each set of plates separately, this is done by immersing a piece of cadmium in the electrolyte and observing the voltage readings between it and the positive and negative elements separately. Before the cadmium is put to use it should be placed in a storage cell, immersed in the elec-

trolyte and remain for about sixty days to oxidize, after which time it is ready for use. If the cadmium is allowed to dry, place in a cell about twenty minutes before making readings. When a battery is discharged, say the potential has dropped to 1.8 volts, the voltage between the cadmium test piece and the positive plate should be about 2.05 and between the cadmium and the negative plate 0.25 volts. The voltage of the cell then would be 2.05 volts minus 0.25 volts or 1.8 volts. On determining when a battery is fully charged make a test while the charging current is flowing at the normal rate, the reading to the positive plate should be about 2.4 volts and to the negative plates minus 0.05 or 0.10, then the total voltage of the cell would be the sum of the two readings, which would equal 2.5 volts. These tests will vary slightly as to age and condition of the battery.

In order to maintain the highest standard of efficiency with telephones, I would add in conclusion the following prevention-first methods:

On installing the new storage battery plant, be sure the initial charge is complete as this controls, to a large extent, the life of the battery. When ready for service follow explicitly the rules for charging and discharging. When the battery is charged daily give an overcharge weekly; in making the overcharge continue the normal charging rate as recommended by the manufacturer for this type of battery, until there is a maximum reading of both voltage and specific gravity for one hour or five fifteen-minute readings on the regular charge. Start the charging current when the battery is from one-third to one-half discharged; this may be determined by the drop in the specific gravity as the drop is in direct proportion to the amount of current used. This may be calculated in the following manner: For example, we have a battery which, when fully charged, delivers 900 ampere hours of current with specific gravity 1200 and temperature of 70 degrees with a range of thirty - eight points drop from fully charged to completely discharged. Then when the specific gravity reaches a value of 1180 you could figure on a reserve of about fifty per cent. Charge then at normal rate until the specific gravity reaches a value of five points below the overcharge of 1200, no more, no less.

The Citizens Telephone Co., of Grantsville, W. Va., has been incorporated with $10,000 capital by Aldine Poling, Russet, W. Va.; J. M. Hickman, White Pine, W. Va.; L. K. Stemple, Bruce Ferrell and B. G. Stump, Grantsville, W. Va.

Phone Development Studies

"Occasional Contributor" in Telegraph & Telephone Journal, London, suggests that a cable lay-out cannot be satisfactory if the engineer's calculations are not based on a reliable development forecast. Few telephone men, he says, can call to mind wastage caused through a too generous forecast; but wasteful reconstructions due to the actual growth exceeding the forecast have been a common experience. In view of the importance of an accurate forecast, information on all points likely to have a bearing upon property development in the area surveyed should be sought in all directions. For this survey work, the most valuable attribute is vision. The officer must be able to visualize what the locality will be like twenty years ahead. Optimism is the next great asset. Many people, unfortunately, get scared at big figures and are inclined to trim down the development in the later periods to some 2 per cent or 3 per cent geometrical increase per annum, regardless of the fact that in America, with a station density of 14 per cent of the population, the increase in one year was at the rate of over 9 per cent per annum.

Above all, the Pessimist must be kept off development work. Even the Optimist must watch that he is in the right mood. For instance, he should never survey on a wet day. What vision can be expected from a man in a soaked mackintosh with a wet plan in his hands. Rather, should he wait for the fine morning, when he can start out with the feeling that "it's good to be alive."

Some knowledge of cable lay-out also will be found of advantage, as the officer will then know where to indicate separate figures for prospective buildings that will require block or internal distribution.

The first and the most important point in survey work is to determine what is likely to be on the ground twenty years hence, and it is here that vision is needed. The Surveying Officer should look over localities which he can remember as a youngster. The progress thus indicated will continue in the future and requires to be fully visualized.

Having determined what is likely to be the property conditions at the ultimate period, the next step will be to decide when the changes are likely to materialize, whether in an early or late period, so that the factors determining the intermediate figures may be fixed. Inquiries should be made of all likely sources, and particularly of the real estate agents usually interested in the locality. In town work, the City Surveyor may be able to assist with information of probable improvement works, whilst in country districts the likelihood of estates coming into the market should be investigated and particularly the possibility of an entail being broken and land thus made ripe for building.

With the increase of fast-moving motor traffic, town authorities will be forced to deal with street widenings and with awkward corners. The consequent improvements will mean the displacing of a number of small properties —with perhaps a density of one line per building—by large blocks of shops, offices or flats property, with a density of from twenty to fifty or more lines per block.

The next step will be to apply suitable density percentages to each class of property. It will be found convenient to fix in tabular form the percentage of density applicable to the various classes of property. The table must be based upon a definite rate policy. It should be assumed that there will be a continuous decline in rates.

When preparing this table, shun the man who says, "You couldn't place telephones in that street if you gave them away." There is a demand for service —at a price—in the poorest quarters.

The figures for the ultimate period having been fixed by application of the proper density percentages for the expected property conditions, the difference between existing and ultimate figures should be divided between the three intervening periods. Proper allowance must be made for the property changes and development anticipated in each period. The development in back street areas may be expected mainly in the last period.

It will be found convenient for town survey, if small rough tracings on paper are taken from the blueprints upon which the forecast figures can be shown. The tracing of the plan should be on the reverse side of the paper, and the top side left free for pencil notes, which can, if needed, be erased without affecting the plan. The plans may be clipped to a stiff cardboard backing by a bulldog clip. The figures can be readily transferred to the blueprints at convenient times.

When the survey is completed the results in total should be tested on a density basis. The existing percentage of lines to stations should be ascertained, and then projected for the period, according to the class of territory. In manufacturing areas, this per-

centage will be likely to fall, possibly as low as 50 per cent or even 45 per cent. In residential districts, however, it will probably not go below 65 per cent or 70 per cent. Having fixed this percentage, the number of stations for each period should be calculated.

The population in the exchange area should be ascertained. These should be plotted on squared paper and the curve projected forward twenty years. Consultation with the town clerk or clerk of the council will be found of advantage in deciding the form this curve should take.

The population twenty years ahead having been estimated, the density percentage of stations to population can then be obtained. In testing for density, it is necessary to take an area which will cover not only business property, but the residential territory surrounding the town.

The growth in each period should be on a progressive scale. Generally the development curve should be a true curve; not like a contour line in hilly country. A review of the figures should be made if it is found that the growth for one period is less than that for the preceding and for the subsequent period.

Before the figures are finally passed, curves should be drawn for line development and percentage lines to stations and for station development in addition to that for population.

There are only two ways of conducting a survey: The wrong way—estimating the telephone possibilities twenty years ahead, of the property as it now exists and based upon present tariff rates; the right way: first deciding what is likely to be the property conditions in twenty years time and then assessing the possibilities on the basis of the lower rates that will then be in force.

Pennsylvania to Meet July 25-27 at Lake Conneaut

Meadville, Pa.—Pennsylvania State Telephone & Traffic Assn's western division is to meet at Lake Conneaut July 25, 26 and 27. Among the features of the program will be addresses by J. K. Johnston on "Plant Appraisals," by H. E. Bradley, president of the association, on "Originating Toll Commissions," and by H. M. Engh of the American Appraisal Co. on "New Basis of Plant Valuation."

Telephone Pioneers Meet

The tenth annual meeting and the second meeting of the general assembly of the Telephone Pioneers of America will be held October 18-20 at Atlanta City, N. J. For particulars regarding hotels and special railroad rates write R. H. Starrett, secretary, Telephone Pioneers of America, 1631 Arch St., Philadelphia, Pa.

Carthage Gets Automatics

Missouri's Third City Growing

Carthage, third largest city of Missouri, is to have a new telephone exchange, which is as up-to-date as the best in the country, and in keeping with the city's growth. Telephone service at present is being furnished Carthage by the Southwestern Bell Telephone Co. giving common battery service, and by the Joplin Home Telephone Co. giving magneto service. To eliminate competition and improve service standards, plans have been completed for merging the two systems and replacing both exchanges with a single Strowger Automatic exchange.

The Home company's office building is company owned, and fortunately is so designed and situated that alterations and additions required by the new equipment may be effected without great difficulty.

Kind of Apparatus to Be Used

The automatic exchange will be of the four digit type with standard three digit code for special services. The initial installation will consist of 1,700 plunger type line switches, trunking to first selectors through 170 rotary secondary line switches. The connectors will be divided into 25 groups, providing 2,500 subscribers' terminals.

Each connector group will consist of seven combination toll and local connectors and one test connector. In this way both the Carthage subscribers and the toll operator will have access to all of the connectors in each group. The toll operator will have access to the connector equipment through a chain of toll selectors.

For private branch exchange service there will be a group of P. B. X. (rotary) connectors, three for the exclusive use of the toll operator and nine for local service only.

An intermediate distributing frame is to be provided so that any line switch may be cross connected to any line in the office. Four party service will be full selective on a jack-per-station basis, using two frequencies with two parties reversed on the line. Eight party service will be semi-selective on a terminal-per-station basis, using two frequencies, reversed line, and one and two rings.

A Fair Deal at Garber

The Garber Telephone Co., Garber, Okla., of which E. E. Mills is president and general manager, has asked the Corporation Commission to authorize telephone rates of $3 per month for business and $2 per month for residence service, a slight increase over present rates. The application is endorsed by Garber City and Chamber of Commerce officials. Municipal improvements of extensive character, including street paving, are necessitating removal of the telephone lines from the streets to alleys and underground conduits and the citizens agree that they should share with the telephone company the financial burden involved in this development.

Calls Monopoly Abhorrent

"As to a monopoly," says Col. Robert W. Stewart, chairman of the board of directors, "the Standard Oil Co. of Indiana appreciates that a monopoly is abhorrent to the minds of the American people, and will not be tolerated by them. This company does not desire, nor does it endeavor, to put any competitors out of business. We believe that our competitors are as essential to our business as our customers. A man or a corporation would be a hundred times a fool who would undertake to get a monopoly on any product or business."

Utility Rate Making Discussed at Iowa University Conference

Iowa City, Iowa.—Public utility rate making and regulation was the subject of a conference called by the College of Law of the University of Iowa, June 26-28. Telephone men who figured prominently in the conference were N. T. Guernsey, vice president and general counsel of the Bell, who spoke on "Regulation and the Telephone," and C. F. Clark of Cedar Rapids on "Telephone Regulation and Rate Making in Iowa."

And Still Room for More

Indianapolis, Ind. — Approximately 70 per cent of the farms in Indiana are equipped with telephones, according to the latest U. S. census. Iowa leads the country with more than 80 per cent of the farms so equipped. Illinois, Kansas and Nebraska rank between 70 and 80 per cent. Ohio is next, and then follow Indiana, Missouri and Minnesota. South Carolina is the tailender, with only one farm in eighteen having telephone connection. The 1920 census shows that 39 per cent of all of the farms in the United States, or approximately two farms out of every five, have telephones.

Saskatchewan province, Canada, is adding 500 miles of new lines to its rural telephone system this season.

Utility Investments Are Safe

By B. E. SUNNY

*Chairman of Board of Directors of Illinois Bell Telephone Co.**

The utilities, with the exception of some street railways and interurban lines, have had a very remarkable and gratifying recovery from the unsatisfactory condition in which they found themselves about three or four years ago. They were then suffering from greatly increased operating expenses and from the difficulty of getting additional capital for extensions. In most cases, too, they had been unable to secure increases in the rates that were fixed by the utility commission prior to the war. Since then, rate adjustments have been quite general, especially with the larger properties, and operating results for the past two years have been more satisfactory.

War conditions subjected the principle of rate regulation by public utility commissions to a severe test, and while there have been complaints of delays in hearing cases and of failure to secure relief, as well as objections to the severity of requirements respecting service, it must in fairness be said that the record made by these regulatory bodies in the several states has been good.

Besides authorizing higher rates, in many cases, they have helped to remove many of the difficulties and dangers to which utility corporations have been subject, among them competition in the same kind of service, which is now generally recognized as an economic blunder and, in many cases, a public nuisance. Under the utility law, no competing utility can begin operations except on a certificate of convenience and necessity issued by the Commission.

Franchise Situation Has Improved

The situation with respect to franchises has been greatly improved. In past years, the franchise of a utility was regarded of vital importance, and the fear that it could not be renewed on its expiration gave considerable concern. Most of the significance attached to franchises in the past has disappeared, because it is now realized that while franchises may end, the property continues undisturbed, and the service goes on as before.

In Wisconsin, telephone companies at least are not required to have franchises. In Indiana, companies having franchises were required to surrender them before they could be recognized by the State Utility Commission. In Ohio, in some instances, franchises have expired, and neither the utility nor the city has bothered to renew them. The franchise has importance nowadays only as outlining the relations between the utility and the municipality with respect to the use of the streets and alleys, compensation, etc.

Public Relations Also Better

Public relations are greatly improved. Attacks on utilities by legislative bodies and newspapers have almost wholly stopped since the creation of public utility commissions. There is a better understanding of the utility problem of operation by the press, and the utilities are supplying a better quality of service and maintaining more satisfactory relations with their customers.

Apparatus Now Standardized

The equipment in use by the utilities is more efficient and permanent. In the early history of the utilities, improvement in apparatus and appliances came with great rapidity, requiring extensive and expensive replacements. It was hardly ever the case that anything wore out but, constantly, valuable apparatus became obsolete and had to be replaced. The equipment now in use by practically all of the utilities represents the last word in design and manufacture and will have a larger chance than heretofore of operating until it is worn out.

As substantial gains have been secured in matters which affect the permanency and efficiency of these properties, and the good-will in which the public holds them, the vital question as to the safety of the utility investments, and their reliability as producers of reasonable returns in interest and dividends has been answered in the affirmative.

Capital Allowed Proper Returns

In many of the decisions by utility commissions and courts in recent years, the principle has been firmly established that the public must be adequately served, and the utility performing the service shall be given rates which will pay all expenses of operating, depreciation, and a fair return on the value of the property employed.

Utility commissions in California, Idaho, Michigan, New Hampshire, New York, North Dakota and Wisconsin have allowed 8 per cent return in some rate cases affecting electric light, water, gas and street railway systems. Decisions by commissions in Missouri, Nebraska and New Jersey have permitted a return of 7½ per cent on water. Commissions in Michigan, New Jersey, Pennsylvania and Virginia have allowed 7 per cent in rate cases affecting telephone, water and gas. Decisions by commissions in Indiana and Illinois affecting telephone service have permitted a return of 6.07 and 6 per cent, respectively, on telephone properties.

As indicating a limitation on commissions in fixing the rate of return too low, the United States Supreme Court, in the Southwestern Bell Telephone case, said that a return of 5⅓ per cent was "wholly inadequate, considering the character of the investment and interest rates then prevailing." (December 1, 1919.)

Safety Margin Is Ample

The average rate of return fixed by the many utility commissions might be said to be 7 per cent, which, on issues of 5 or 6 per cent first mortgage bonds, representing 50 or 60 per cent of the value of the property, could be almost regarded as a *guaranteed revenue* of more than twice the interest charge. This, consequently, makes these bonds very secure.

The Supreme Court decision referred to also disposes of the controversial question as to the method to be employed to ascertain the *value* of the property. The rate of return has in some cases been based upon the original cost, or the book value, and only occasionally on the cost of reproduction. The court decides that the cost of reproducing the property is the right basis for fixing rates. It affirms its policy with respect to such matters, as expressed in other cases, as follows:

"There must be a fair return upon the reasonable value of the property at the time it is being used for the public, . . . and we concur in the court below in holding that the value of the property is to be determined as of the time when the inquiry is made regarding rates. If the property which legally enters into consideration of the question of rates has increased in value since it was acquired, the company is entitled to the benefit of such increase."

Can't Confiscate Property, Says Court

In another case the court rules that: "The making of a just return for the use of the property involves the recognition of its fair value, if it be more than its cost. The property is held in private ownership, and it is that property, and not the original cost of it, of which the owner cannot be deprived

*Extracts from an address before Bond Men's Club of Chicago, June 14, 1923.

without due process of law."

An additional extract from a former opinion is as follows: "It is impossible to ascertain what will amount to a fair return upon properties devoted to public service without giving consideration to the cost of labor, supplies, etc., at the time the investigation is made. An honest and intelligent forecast of probable future values, made upon a view of all of the relevant circumstances, is essential. If the highly important element of present costs is wholly disregarded, such a forecast becomes impossible. Estimates for tomorrow cannot ignore prices of today."

This Decision Clears the Situation

As a check on the tendency of state utility commissions to go farther in regulating the utilities than the law contemplates in saying what obligations shall be undertaken, salaries and wages paid, etc., the supreme court says: "The commission is *not* the financial manager of the property, and it is *not* empowered to substitute *its* judgment for that of the directors of the corporation, nor can it ignore items charged by the utility as operating expenses unless there is an abuse of discretion in that regard by the corporate officers."

This decision, which defines the status of the commission and the utility, will greatly simplify negotiations concerning rate changes, in that commissions now will omit the discussion of many phases of utility affairs to which they have heretofore given time-consuming consideration.

Utility Securities Are Almost Perfect

As to the safety of investments in securities of gas, electric light and telephone companies, it can be said that issues of bonds and notes in the hands of the public have made an almost perfect record; there seems to be no default by any of them so far as inquiry among men well informed on the subject is concerned. I say "almost perfect," because there are no doubt some small, indifferently managed companies that have fallen down, but the big companies have made a gratifying record, not only with respect to bonds and notes, but preferred and common stocks as well.

In the beginning of these remarks, I said that the utilities, except the street railways, were prosperous. The street railways are in a class by themselves and have had a difficult time of it, somewhat because of the fights for a 5-cent fare in New York, Chicago and other cities, which have been widely advertised and which have influenced the attitude of officials and the public toward the street railways in other places. We do not need to go outside of Chicago to realize the destructive force of political propaganda on the credit and standing of a utility, although there are examples in New York and elsewhere. The fight carried on here for five years by the city against the street railway, the basis of which was obviously political, was unparalleled in its severity and bitterness, and very seriously injured the credit and good will of the corporation.

Telephones Haven't All the Troubles

We all realize that successful government depends upon the co-operation of the citizens; likewise, a successful utility must have the co-operation and friendship of those whom it serves. The Chicago Street Railway, as far back as anyone can remember, has had greater difficulty in securing and holding the co-operation of the public than any of the utilities, because it has had the hardest service of them all to perform. The telephone, gas and electric light companies are difficult and complicated, but they are simple and easy as compared with the street railway. Its service is personal, and the problem of the management is to guess as nearly as possible where, and when, and how many passengers will congregate to be carried some place, and in how many directions, and how far they will go, and to have cars in readiness to transport them. The best guesser is the best manager, and he must make a different guess for a wet and a dry day, a hot or a cold day, and on a dull or a busy day, if he would give good service.

Problems of the Street Railways

Perfect service would be a clean, properly heated car, with a vacant seat at your corner, without having to wait, and a fast ride, with but a few stops, to your destination. Your opinion of the service is lowered in proportion to your disappointment with respect to the realization of any of these items. In the nature of the business, there are, and always have been, plenty of disappointments because the impossibility of furnishing anything approaching a perfect service is inherent in the business. The capital expenditure and the operating expenses to provide enough cars to carry every one satisfactorily is prohibitive and, furthermore, there is insufficient room on the streets for the cars if they could be provided. Municipal ownership and control in Chicago would not remove a single objection to the present service that could not be removed under private ownership with the co-operation and help of the city.

Municipal Ownership Is Showed Up

It is no reflection on the City of Chicago, or any other American city, that it cannot operate a utility as satisfactorily as it can be operated by private management. With a complete change of personnel in the city administration every few years, there is an absence of the continuity of policy or plan so necessary in any business enterprise. If the executives and heads of departments of manufacturing concerns, banks, newspapers, packing houses and public service corporations stepped out of office in a body every two or three years and their places were taken by men of little or no previous experience in the particular line of business, which is what occurs in governments after each election, we would shortly have no business left. It is a tribute to the vitality of our form of government that the governmental structure can sustain these violent shocks, periodically, without breaking down.

Chicago Cited as an Example

We have an example of municipal ownership and operation in our water works, one of the easiest of the utilities to operate—especially in Chicago, where we have an abundance of good water at hand. In a report by the engineers, published recently it is pointed out that half of the water pumped is wasted, and that, by certain changes that should be made, $88,000,000 could be saved in additional investments in a period of years, and $145,000,000 in reduced operating costs. This is no new discovery. Reports of this general purport have been given to the public periodically during the past dozen years. Besides the loss by waste, the supply from the nearby intakes is frequently unfit for use, and the service is grossly inadequate in that it is impossible to secure water above the third story in the summer time. It is necessary in buildings more than three stories high to install pumping apparatus, costing from $1,000 to $75,000 per building, to lift the water from the point where the city pumps fail. Looking from the windows of any skyscraper to the roofs of the lower buildings, each equipped with its tank for caring for the water supply, it is evident that an important part of the service has been supplied by the property owners.

What Corporate Utility Gets Such Aid?

It goes without saying that this situation would not be tolerated if the water works belonged to a private corporation. If it were impossible to get telephones or electric light above the third story, unless the customer supplied accessory service for the purpose, the situation would be corrected with amazing speed by the force of public sentiment. Obviously, it would be bad judgment and a costly blunder to allow municipalities to take on any additional burdens.

Utility Bonds Above All Others

Of the four classes of bonds—municipals, utilities, railroads and industrials

—I have a confidence in the utilities that is derived from fifty years' experience with them, and I regard utility bonds in their safety as an investment next to municipals. As an economic proposition, utility bonds are frequently superior to municipals because they are on self-supporting properties, while there are many issues of municipal bonds representing water works and electric light and street railway properties that operate at a loss and are a charge against the public credit.

Government Ownership Not Feasible

The agregate of the services rendered to the citizens by the several utilities is vastly more important than the services rendered by government, and could not be undertaken and performed by the government in addition to its present burdens. The government and the utilities combined are performing the public service of the country, and no doubt always will do so. The utilities are that part of the government that is not in politics—an advantage over their associates in public service which should make it easy for them to hold their own and continue to grow and prosper, as they are certain to do.

Northern Indiana Meet at Lake Wawasee

Officers Elected

W. F. Van Horn, Wabash, Pres.

Sam Tomlinson, Plymouth, V. P.

Roscoe Pontius, Rochester, Sec.-Treas.

Walter J. Uhl, Logansport, and Frank V. Newman, La Porte, Directors.

Lake Wawasee, Ind.—At the Soutl. Shore Inn, June 12-14, the Northern Indiana Telephone Assn., held a successful mid-summer convention. One of the highlights was the address on the financing of smaller Independent plants, which was made by R. B. Still, president of the Texas Independent Telephone Assn. Customer ownership also was featured in the address of Public Service Commissioner Edgar M. Blessing of Indianapolis, who emphasized the need for service improvement in every detail. Better maintenance of toll lines was stressed by Henry Barnhart. An operators' conference, which opened with the address of Col. Seymour Bullock, South Bend, on "Woman", was one of the convention's best bets. Miss Marguerite Norris of La Porte, conducted the conference. Talks were made by Miss Ethel Anglin of Leesburg, Miss Belle Bernetha, Rochester, Lorette Pesch, Plymouth, E. L. Gaines, Fort Wayne, A. M. Taylor, South Bend, D. H. Whitham, Indianapolis, and J. Lowman, South Bend.

Alloys Aid Our Industry

Here are some thoughts that a Chicago newspaperman jotted down recently for the "Daily Tribune," after he had visited that city's first Bell automatic telephone exchange:

Ten years ago, he writes, the first cost of such exchanges was terrible, because of the quantities of platinum needed. Since that time the cost of platinum has soared to dizzy heights—war and women have both devoured it. However, the platinum problem has been solved, mainly by the development of alloys to take its place. The quantity needed in telephone machine switching has been reduced year by year. It is not improbable that future historians will fix upon the development of alloys as a decisive achievement of our period. Everybody is more or less familiar with the progress in alloyed steel which has made most of our high speed machinery possible. The debt of the automobile industry to the alloys evolved by the steel makers is known from one end of gasoline alley to the other. But the importance of the nonferrous alloys is not so well understood.

As a result of the work of the Bell metallurgists in developing a light lead and antimony alloy for cable sheathing, the capacity of local and long distance lines has been multiplied immensely. The same pole lines, which used to carry one or two cables, can now carry a whole flock of them. Within the cable the size of the wires has been reduced almost to the vanishing point. Formerly, long distance wires were as thick as a pencil. Now they are about the size of thread. A single cable of the type now under construction will carry 2,400 pairs of wires. On every pair, three conversations can be carried on simultaneously, as a "phantom" circuit is used in connection with each pair of wires. The use of the small wires was made possible by improved current transmission, which was mostly due to the invention of the Pupin coil.

Substitutes for platinum now used in machine switching are expected to save the Bell system $500,000 per year in first cost of new stations to be installed under present plans at Chicago. Since 1916 the use of these alloys and improved contact methods have saved the concern $13,000,000. The use of the new alloy for cable sheathing has saved since 1913 about $6,000,000 in first costs and $800,000 in annual charges.

Until recent years, machine telephone systems had two other big handicaps. When the number of subscribers ran much above 20,000 it was necessary to duplicate the entire equipment to add a few more, and so on ad infinitum. The switchboards also had the habit of standing up a while, and then going to pieces almost totally, when deterioration set in. All this has been overcome—and by inventors whose names you will never hear.

New Line to Coast

Second Transcontinental Route Being Built from Denver to Los Angeles

The Mountain State Telephone & Telegraph Co., in conjunction with the American Telephone & Telegraph Co., will build a second transcontinental line from Denver to Los Angeles. It will necessitate the construction of new pole line between Denver and Colorado Springs in Colorado, the villages of San Antonio and Rincon in New Mexico and from Maricopa to Phoenix in Arizona. Construction will be started immediately, the first unit to be built between Phoenix and Yuma. The completed circuit is expected to be in operation by January 1, 1924. The route will be Denver to Colorado Springs, Pueblo, Trinidad, Raton, Las Vegas, Albuquerque, near Santa Fe, Socorro, Las Cruces, El Paso, Deming, Lordsburg, Tucson, Phoenix and Yuma to Los Angeles. The California section of the line is being built by the Pacific Telephone and Telegraph Co. in conjunction with the American Telephone and Telegraph Co. Central office equipment for the new line will be installed at Trinidad, Las Vegas, Albuquerque, El Paso, Tucson, Phoenix and Yuma.

Southern New England

Boston, Mass.—Special stockholders' meeting of The Southern New England Telephone Co. at New Haven, June 25, acted favorably on two specific proposals: First, to accept an amendment to the charter increasing the "legislative limit" of capital stock from $20,000,000 to $40,000,000; second, to authorize directors in their discretion to issue additional capital stock up to $30,000,000. Southern New England Telephone now has $18,000,000 stock outstanding, out of $20,000,000 authorized. It is proposed to issue $3,000,000 additional, which will make $21,000,000 outstanding, $30,000,000 authorized by stockholders and $40,000,000 authorized by the legislature. The money will be used to pay off bank loans incurred for new construction. Southern New England stock pays 8 per cent and has a market of 127-130. American Telephone owns 33 per cent of the stock.

Valuation in Rate Making

Chapter XVI—On Collateral Construction Costs

By Charles W. McKay, Associate Editor*

We began the discussion of "Collateral Construction Costs" in the May issue, but diverged from the subject, in the June issue, to comment upon the unusually interesting opinion handed down by the Supreme Court of the United States as of May 23, 1923. In the May issue, it will be remembered, a table was presented (Fig. 35), illustrating the correlation of the various elements of total value. In connection with the discussion of this table the items Omissions and Contingencies; Warehouse and Purchasing Expense during Construction; Tools and Tool Expense during Construction and Contractors' Profit were commented upon in some detail. These items, it will be remembered, are really a part of the total direct construction costs—although they are frequently considered in connection with the Collateral Costs, due to the fact that they are not included in the unit costs.

Before discussing the collateral costs, proper, it may be well to present a recapitulation—which will serve to again direct the reader's attention to the correlation of the items of collateral costs to the other elements of total cost or value. Such a recapitulation is presented in Fig. 36.

It will be noted that the items Omissions and Contingencies; Warehouse and Purchasing Expense; Tool Expense, etc. (as discussed in the May issue) have been included with the total direct construction costs. The items we are now concerned with are the following: General and legal expense during construction; engineering and general supervision during construction; taxes and insurance during construction, and interest during construction.

In connection with Fig. 36 it will also be noted that the collateral construction costs are so closely allied to the direct construction costs as to warrant the inclusion of both these items under the general caption "Physical Property." To emphasize the close relation between the collateral costs and the direct construction costs—the following is quoted from the writer's book, "Telephone Rates and Values":

"Before taking up the discussion of the various elements of collateral cost, let us consider for a moment just what happens prior to and during the early stages of the construction of a utility property.

"First comes the conception of the idea. If the plant under consideration is a telephone plant, some practical telephone man usually first sees the opportunity for a new company. Or, it may be that a group of prominent citizens, dissatisfied with the service of the existing company, conceives the idea of starting a competitive enterprise financed by local capital."

(Author's Note. In connection with the foregoing statement it may be well to suggest the thought that "competition" in the telephone field is practically a dead issue. The text of the book "Telephone Rates and Values" was written a number of years ago—at a time when there were a large number of competing telephone companies. Now, as a rule, competition is largely eliminated—one company serving a given territory, this company being an Independent company or a Bell company—depending upon the exigencies of the case in question.)

"In either case the next step will be the discussion of the project with others who may be usefully interested, especially those who may be of direct financial assistance.

"If, after conferences, the project still seems feasible, engineers will be employed to make rough estimates of costs, and to outline, in a general way, the scope of a property adequate to give the desired service. The consideration of the engineer's report will probably necessitate a number of conferences, and possibly several inspection trips.

"If the financial backers are favorably impressed with the findings of the engineering staff, the next step will be the employment of legal counsel to take the preliminary measures toward obtaining the consent of the State Public Service Commission; the securing of municipal franchises and for general advice in whatever other organization problems may arise.

"In some states a 'certificate of public convenience and necessity' is required before a utility can enter the field. In other words, the promoters have to prove to the state public utility commission that there is a real need for a new utility corporation—before the commission will consent to its establishment.

"After the consent of the state commission has been obtained the work of securing a municipal franchise is taken up in earnest. This, as a rule, is a rather serious problem, involving conferences and a considerable loss of time. Factions of the city government may have to be conciliated, for political or other reasons.

"Next comes the organization of a corporation to take over the franchise and build the plant; the acquisition of the necessary real estate and the preparation of specific engineering and architectural plans for the construction of the plant.

"From the foregoing it will be seen that very appreciable expenditures have to be made before a single item of the inventoriable portion of the plant is brought into existence. No fair-minded person can for a minute question that these expenditures are just as much a part of the cost of the property as the cost of placing poles or stringing wire.

"All of these expenditures, with the exception of the cost of securing the franchise (other than the purely legal franchise cost) and the cost of raising money for plant construction fall under the 'collateral costs.'"

General and Legal Expense During Construction

This item includes the salaries of general executives; general office expenses and retainer for legal counsel—during the construction period. It is frequently computed on the basis of a percentage of the total of the direct construction costs—and when so computed the allowance often ranges from two to six per cent. Frequently, however, detailed estimates are computed of the total of the general and legal expense. When making such estimates it is necessary to take into consideration the period required for constructing the physical property; salaries of executives and assistants; retainer for legal counsel; office rental and other incidental expenditures.

Classification	Reproduction Cost	Present Value
TOTAL DIRECT CONSTRUCTION COSTS (including Total Inventoriable Property; Omissions and Contingencies; Warehouse and Purchasing Expense; Tools and Tool Expense, etc.)	$.....	$.....
COLLATERAL CONSTRUCTION COSTS		
General and Legal Expense during Construction	$.....	$.....
Engineering and General Supervision during Construction	$.....	$.....
Taxes and Insurance during Construction	$.....	$.....
Interest during Construction	$.....	$.....
TOTAL COLLATERAL CONSTRUCTION COSTS	$.....	$.....
TOTAL PHYSICAL PROPERTY	$.....	$.....
TOTAL NON-PHYSICAL ASSETS (including Cost of Establishing Business, Cost of Financing, etc.)	$.....	$.....
GRAND TOTALS	$.....	$.....

Fig. 36

Illustration of Correlation between Direct Construction Costs; Collateral Construction Costs, and Non-Physical Assets

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Engineering and General Supervision During Construction

As suggested—in the quotation from "Valuing Industrial Properties"—preliminary engineering estimates and plans are essential, these preliminary plans being followed by detailed working plans and estimates. The cost of engineering is usually computed at a percentage of the total value of the inventoriable property. The allowance may range from three to six per cent—dependent upon the peculiar conditions involved in the case under consideration.

In our consideration of the unit cost problem we have seen that the "direct supervision"—i. e., the supervision accorded to the work by the gang foremen—is included directly in the individual unit costs. On the other hand, all executive supervision is provided for under the preceding item "General and Legal Expense during Construction." All supervisory effort which does not come within the scope of the duties assigned to the general foreman, and which cannot be allocated to the general executive staff is classified under the category "General Supervision." General Supervision may include the salaries of General superintendents, general foremen, their assistants and also all of the miscellaneous expenditures incidental to their work.

The cost of general supervision during construction is frequently computed in detail, and when so computed it should include the salaries of general superintendents, general foremen, clerks, stenographic help, office rentals, office supplies (for the above forces), etc.

Frequently in connection with small properties, it is customary to compute the cost of "Engineering and General Supervision" as one item. When this method is adopted an allowance of five or six per cent of the total cost of the inventoriable property will usually suffice to cover the combined costs of "Engineering and General Supervision during Construction."

Taxes and Insurance During Construction.

During the construction period certain tax charges and certain insurance charges accrue against the property—and until such time as the various units of plant are actually cut into service these charges should be allocated to the capital accounts, rather than to the expense accounts.

The allowances for the item "Taxes and Insurance during Construction" are often computed in detail. When the detailed method of computation is adopted it is necessary to work out a construction period and to make certain assumptions as to when the various taxable and insurable units will be out into service.

A shorter method of computing the cost of taxes and insurance during construction involves the use of a percentage applicable to the total cost of the inventoriable property. Such a percentage, of a necessity, must be predicated upon established precedent in other similar cases. This percentage may run from three to five per cent (or more) of the total cost of the inventoriable property.

Interest During Construction

Courts and commissions are generally agreed as to the propriety of including an allowance—for the capital used in constructing a telephone property (during construction period) in the total rate base value.

As in the case of the other items of collateral cost, there are two possible methods of computing the allowance for "interest during construction." A detailed construction period may be assumed and interest computed annually, semi-annually or quarterly. If this method is used, the interest charges cease to be a portion of the rate base value as soon as the various units of plant are put into active service.

A shorter method of computing interest during construction involves the use of a percentage applicable to the total cost of the inventoriable property. This percentage may range from five to eight per cent of the cost of the inventoriable property—the exact percentage being dependent upon the exigencies of the case under consideration.

(To be continued in August)

Automatics on Conte Verde

The automatic inter-communication telephone system on a liner nowadays is considered one of the most important features of the equipment. An installation of the most modern type has just been fitted on the steamship "Conte Verde," of the Lloyd Sabaudo Line. This system was manufactured and installed by the Relay Automatic Telephone Co., Ltd., of Marconi House, London, a similar exchange having been installed on the S. S. "Conte Rosso" last year with eminently satisfactory results.

The "Conte Verde" will carry an automatic exchange with 26 initial connections, and capable of extension up to 35 lines at any time without disturbing the existing service. Automatic telephones are fitted in the navigating offices, cabins, engineers' quarters, state rooms, smoke rooms, saloons, etc.

From a shipbuilding point of view, the simplicity of running only twin wires in lead-covered cables is a great advance on the multi-cables required in the old-fashioned inter-communication systems.

The essential value of the "Relay" Automatic Telephone lies in the facility of its working, in its exemption from the liability of being thrown out of gear, and in the fact that the apparatus is not affected by climatic fluctuations. Its efficient automatic principle, dispensing with the attendance of an operator, insuring prompt connections and avoiding mistakes in numbers obtained, are outstanding recommendations so far as concerns the convenience of users of this form of inter-communication service. This telephone system, in fact, constitutes a striking feature of the luxurious new vessel.

U. S. Also Puts One Over

When the Leviathan went into transatlantic service, July 4th, it was the first ocean liner, completely equipped with an intercommunicating telephone system, that can be connected with the New York Telephone Co.'s system while in port at that city. This makes available to persons on shipboard telephone connections with any points in the entire American Bell System.

The big ship's telephone system was installed as a part of the fitting up process when the liner was in drydock in Newport News, the work being done under the direction of the Western Electric Co., whose standard telephone apparatus was used. The heart of the system is a three-position private branch exchange switchboard which serves 600 telephones placed in cabins and throughout the ship's establishment. In making the installation, it was necessary to use an especially constructed heat-resisting cable because of the intense heat in some parts of the ship below decks, particularly in the vicinity of the engine room.

As soon as the liner is alongside of her berth the switchboard is connected to the general Bell exchange system through the Lackawanna central office. On days of sailing to foreign ports, the ship's land-connected telephone service will be maintained until the moment of departure.

Although telephone communication between shore and shipboard has been used on a small scale before, nothing so elaborate as the Leviathan's facilities, enjoying connections with the entire Bell System, has ever before been attempted.

Type A 27 Pole Cable Terminal

Type A27
Pole Cable Terminal
Fits Pole
No Gaining

Equipped with P495
Self-Cleaning Sawtooth
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P495

STANDARD SCREWS (BB-10-26)

Properties of Standard Screws

INTERNATIONAL STANDARD THREAD. The form of the International thread is the same as that of the U. S. Standard thread and its dimensions are metric. The clearance at the bottom of the thread adopted by the International Congress (1898) is to be one-sixteenth of the height of the original triangular section taken before the top of the thread is flattened off or the bottom of the thread is filled in. The shape of the bottom of the thread resulting from this clearance is left to the manufacturers, but a rounded profile for the bottom is recommended.

INTERNATIONAL STANDARD THREAD

Diameter Mm.	Diameter In.	Pitch Mm.	Root diameter Mm.	Root diameter In.
3	0.1181	0.55	2.29	0.0900
4	0.1575	0.70	3.09	0.1217
5	0.1969	0.85	3.90	0.1534
6	0.2362	1.00	4.70	0.1851
7	0.2756	1.00	5.70	0.2245
8	0.3150	1.25	6.38	0.2511
9	0.3543	1.25	7.38	0.2904
10	0.3937	1.50	8.05	0.3170
11	0.4331	1.50	9.05	0.3564
12	0.4724	1.75	9.73	0.3830
14	0.5512	2.00	11.40	0.4489
16	0.6299	2.00	13.40	0.5276
18	0.7087	2.50	14.75	0.5808
20	0.7874	2.50	16.75	0.6595
22	0.8661	2.50	18.75	0.7381
24	0.9449	3.00	20.10	0.7911
27	1.0630	3.00	23.10	0.9095
30	1.1811	3.50	25.45	1.0020
33	1.2992	3.50	28.45	1.1201
36	1.4173	4.00	30.80	1.2126
39	1.5354	4.00	33.80	1.3307
42	1.6535	4.50	36.15	1.4232
45	1.7716	4.50	39.15	1.5413
48	1.8898	5.00	41.51	1.6343
52	2.0472	5.00	45.51	1.7918
56	2.2047	5.50	48.86	1.9235
60	2.3622	5.50	52.86	2.0810
64	2.5197	6.00	56.21	2.2130
68	2.6772	6.00	60.21	2.3705
72	2.8346	6.50	63.56	2.5023
76	2.9921	6.50	67.56	2.6598
80	3.1497	7.00	70.91	2.7918

FRENCH SYSTEM. The thread form and diameter sizes correspond in general to those of the International system, but the pitches and root diameters are different in a number of sizes. The French metric thread, for this reason, must not be confused with that of the International metric standard.

COMPILED BY
J. B. RATHBUN

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TELEPHONE ENGINEER

BB-10-26

STANDARD SCREWS (BB-10-35)

Tapping and Thread Cutting Data

TAP DRILL DIAMETERS. Trouble in tapping holes is very frequently caused by using tap drills that are too small in diameter, and very often the peculiarities of the materials tapped are not taken sufficiently into account. Again, we must take into account the differences due to hand and machine tapping where accurate production work is undertaken.

For ordinary manufacturing operations not more than 75 or 80 percent of the standard thread depth is necessary, and if the screws enter the tapped hole for a distance greater than 1.5 times the diameter, one-half the full thread is all that is necessary. A short tapped hole calls for a greater percentage than a deep hole for reasons easily seen. When threads are to have a depth equal to 0.75 of the standard thread depth, then the diameter of the tap drills can be found from:

$$d = (D - 0.75) \times 2t$$

Where d = diameter of tap drill,
D = diameter of tap or screw thread,
t = depth of thread (Standard).

This applies to all thread forms, either United States Standard or "V" forms. The size of tap drill should not be less in any case than given by the above formula for a smaller drill greatly increases the danger of broken taps, increases the power required and frequently leads to a poor thread.

A small tap is permissible in crystalline materials such as cast iron than with softer and tougher materials. Drills for tapping aluminum, copper, tough wrought iron, Norway iron, etc., should be larger than those used for cast iron, hard brass and similar materials. With the tapped thread depth of 0.75 of the standard depth for cast iron, the depth for aluminum and similar metals should be decreased still further. In the following table, the tap drills specified allow for a thread of 0.75 of the standard thread depth.

TAP DRILLS FOR U. S. STANDARD SCREW THREADS

Thread diameter inches	No. threads	Drill diameter inches	Thread diameter inches	No. threads	Drill diameter inches	Thread diameter inches	No. threads	Drill diameter inches
1/4	20	7	1/2	10	29	1 1/8	6	1 3/4
5/16	18	F	9/16	9	31	1 1/4	6	1 11/16
3/8	16	5/16	5/8	9	33	1 3/8	5 1/2	1 15/16
7/16	14	U	11/16	8	35	1 1/2	5	2 1/16
1/2	13	27/64	3/4	8	37	1 5/8	5	2 3/16
9/16	12	31/64	13/16	7	39	1 3/4	4 1/2	2 5/16
5/8	11	17/32	7/8	7	41	1 7/8	4 1/2	2 7/16
11/16	11	35/64	15/16	7	43	2	4	2 5/8
3/4	10	11/16	1	7	45	2 1/4	4	2 13/16

In making allowances for the difference between machine and hand tapping, it is safe to give 0.1 more of a full thread for hand tapping than for machine work. In other words if 0.75 of a full thread is allowed for hand tapping, then 0.65 of the standard should be used for machine tapping.

The breakage of taps can be greatly reduced by the use of a proper lubricant and by the same token a smaller tap drill can be used with safety when a good lubricant is used. The importance of such a lubricant is specially of importance when tapping such metals as aluminum, copper and wrought iron. Lard oil, sperm oil or graphite and tallow are the best for iron and steel. For tapping long holes a little kerosene is effective.

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BB-10-35

Everyday Telephone Helps

Third of a Series of Articles for Beginners; for Students, Small Plant Managers, Rural Line Owners and Others — Fundamental Facts, Principles and Practices—This Chapter Is About Batteries, and Their Uses

By P. Kerr Higgins

Batteries are of two kinds, primary and secondary, and the latter are subdivided into dry and wet cells. At this time we are only concerned with the consideration of primary batteries and will defer the discussion of secondary batteries until later on in the series.

The first primary cell was discovered about 1800 and from then until about 1870, when the dynamo was invented, primary cells were the chief source of electric current. Practically all of the types in use during this period were of the wet type.

Dry Cells Now Almost Exclusively Used

It now has become standard practice to use dry cells exclusively at the substation and so we will consider this type first and discuss the wet type later. Some of the requirements of a good battery are as follows: Must possess constant high voltage (E.M.F.), have low resistance (R), be inexpensive, have minimum deterioration, have practically no consumption of material when not in use, be convenient in form, be easy of access for inspection and repairs, be clean, and must have suitable means for making connections. Spring connectors have been found to be the most suitable for this purpose. The minimum standard for long distance requirements is 2.8 volts for three cells. It is necessary to use only two cells of battery on most makes of telephone as the transmitters are designed to operate on this number and added cells usually have a tendency to burn the electrode of the transmitter or produce a frying sound in the receiver when the transmitter is in use. The cut-off point or the point at which cells must be changed is approximately .9 volts per cell and some commissions are insisting upon this minimum standard for transmission purposes.

The efficiency of a dry battery is determined by the number of hours of service delivered above this cut-off point. The comparative cost of a set of batteries for each hour of heavy service can be determined by adding the original cost per set to the freight, drayage and average installation expense, and dividing by the number of hours of service delivered by each cell before the cut-off point is reached.

Telephone Company Should Make Battery Tests

Battery tests can only be made with reasonable accuracy in the storeroom, as the conditions in practical service are so varied as to make a comparison almost impossible. The writer has had a bitter experience through experimenting with new types of cells, taking for granted that the tests and data submitted by the maker were correct. It is suggested that each company should make tests for itself and decide which cell meets its requirements best. The writer has found the following tests suggested by a telephone manufacturer to be very satisfactory:

"The first test is what is known as the 'accelerated' test, which any telephone man can make by putting three cells of two or three different makes on an ordinary local battery operator's set, and if the listening keys are provided with battery cut-in contacts, these should be short circuited (or one of the listening keys tied in tilted position) to increase the battery usage and so accelerate, or 'hurry up' the test. The battery circuit must be opened at night, by pulling out the operator's plug, and so permit the cells to show their recuperative ability. A record should be kept as to the hours when the three cell battery is put to work and when the circuit is opened so the number of hours of service delivered by each can be determined.

"The only instrument needed is an ordinary voltmeter. Voltage tests, on each of the three cells, should be made each morning, five minutes after the operator's plug has been inserted. The same transmitter should be used throughout the test and, at reading time, it should be in talking position, but should not be talked into while the voltage readings are being taken. Voltage readings should also be made each evening just before the operator's plug is pulled out for the night.

"By taking these voltage readings on the individual cells WHILE THEY ARE AT WORK one can tell just how each cell is contributing to the total voltage maintained across the transmitter circuit. At the start all three cells will probably be found testing nearly 1.5 volts each, but after a very few days the better cells will begin to show their superiority and when any cell drops to nine-tenths of a volt after five minutes service, it should be considered 'spent' and the number of hours of service previously rendered should be computed and credited to it, and the cell in question removed and the same procedure followed when the two remaining cells reach the nine-tenths 'cut-off' point.

"If it is desired to observe the behavior of the spent cell below the .9 volt point, it can be left in service until it goes completely dead or reverses its polarity, for, unless removed when it becomes dead, it will reverse itself and so oppose the remaining cells that good transmission cannot be given. After the second cell has been removed and only one remains, it is permissible to connect one new cell with the 'winner' until the latter has reached the cut-off point. Otherwise sufficient voltage for good transmission cannot be had.

"So much for the 'accelerated' test which is valuable for comparing cells of the same class and getting results within a few weeks. The writer's experience shows that if two or more 'telephone' cells are tested in this manner the results of the 'accelerated' test bear about the same ratio as the results of THE STANDARD TELEPHONE SERVICE TEST as recommended by the Bureau of Standards, at Washington, D. C. *(See Editor's footnote.)

"This test requires an Automatic time clock and is too elaborate to undertake, but it faithfully represents three cells of battery on a twenty ohm transmitter of a frequently but briefly, used subscriber's telephone. This test determines the actual days of service given by three dry cells above the A. T. & T. Co.'s 2.8 volt cut-off point. It even takes into account the frequent less usage of the telephone on Sundays, but it is, in reality, an 'accelerated' test as the current flow is about twice as heavy as on average two-cell telephones.

*Editor's Note.—Information regarding these tests may be obtained by sending 15 cents in coin or money order to Superintendent of Documents, Government Printing Office, and asking for Bureau of Standard Circular, No. 79, on "Electrical Characteristics and Tests of Dry Cells," second edition.

"This condition has led the leading manufacturers of telephone cells to adopt, in connection with the standard test, a special three-cell test through 50 ohms. This accurately represents the current flow of two cells through the average modern, high resistance transmitter and gives an accurate line on the number of days service that will be delivered on a modern two-cell telephone.

"But this test, being just as difficult to make as the standard test, is likewise beyond the reach of the average operating company.

"However there still remains abundant opportunity for such companies to accurately compare dry cells for telephone service without wasting cells or spending much time in making the tests.

"Any pole changing ringing device using dry cells for ringing power in a large magneto exchange, is almost exactly comparable with the standard three-cell transmitter test as to number of day's life, above the .9 volts per cell cut-off point, while the same ringing equipment, in a small magneto exchange, is comparable in current consumption to the lighter 50 ohm test and to the average number of days' service received from dry cells, when used in pairs, in modern two-cell telephones.

"When placing new ringing cells on the dry battery pole changer, different makes or types of new cells may be connected in series and voltage readings taken and recorded once or twice per week, until the cells reach the .9 volt cut-off point when the number of days' service rendered by each of the cells gives an accurate line on the relative life they will deliver on two-cell telephones.

"However, to make the test comparable to telephone conditions, the voltage readings must be taken under approximately normal transmitter current flow, which can be secured by connecting a 110 volt, 15 or 25 watt Mazda lamp across the ringing battery supply posts of the pole changer. If 90 volts or more of ringing battery is employed the 15 watt lamp should be bridged during the test. If less than 90 volts is used the 25 watt lamp should be bridged. The voltage readings should not be taken until the lamp load has been on for two minutes and the lamp has settled down to a definite and uniform brilliancy. The voltage readings should be taken during the intervals when the operator is not ringing on heavily loaded lines.

"Only a few cells of each make need be read, and if old cells near opposite ends of the row under test show very nearly the same, the readings should immediately be remade in reverse order and the two voltages averaged for with a single reading the cells first tested have a trivial advantage over those tested after longer exposure to the lamp load.

"Lastly, there remains the test of actual transmitter service, but as no two telephones are subjected to the same traffic load, the only way of comparing any cells is to put two or three cells of different makes in series on the same telephone and again note the number of days' service delivered by the individual cells before they reach the .9-volt cut-off point. The cells need not be tested daily, as an occasional test will show the approximate time when the weaker cell will reach the discard point, and only as it nears this point need tests be made frequently. These tests should be made with a voltmeter after the receiver has been off the hook for two minutes.

"Three cells on a busy business desk will give fairly quick returns, while two cells on a residence wall set will give comparative service values for the lightest current drain known in telephone service.

"As a general proposition the highly accelerated tests, which exhaust the cells quickly, give an unfair advantage to the high amperage ignition type cells. Should such cells be found to compare favorably with the lower amperage Special Telephone cells on operator's transmitter service, such results must not be taken as conclusive until supplemented by the more prolonged tests of pole changer and subscribers' telephone service, for on these latter tests the low amperage telephone cells are sure to show up much more favorably.

"In all of the foregoing tests all cells are necessarily subjected to the same ampere hour discharge, and while this should be multiplied by the average voltage maintained by each cell to determine the watt hours, or actual power, delivered by each cell, it is only necessary in these tests to observe the number of days' service before the cell reaches the .9-volt cut-off point.

"The voltmeter used should be accurate and reliable, with a total reading not exceeding 3 volts, so that one new cell will read up to the middle of the scale. Amperage readings under short circuit have nothing in common with the extremely light drains of telephone service. Voltage readings under open circuit are likewise most misleading. The only real test is to put the cells to work under a uniform current load, comparable to the work to be done, and by taking voltage readings while the cells are on normal duty, we not only find which are the workers and which are the shirkers, but also learn how soon each cell reaches exhaustion.

"Making these tests is a simpler matter than giving this accurate description of the proper methods. Any telephone man who will go to the trouble of making these observations of dry cells in regular service will have the satisfaction of substituting scientific facts for guesswork, or possible prejudice, and can select the dry cell actually proven to cost least per day of service in his own plant."

Construction of Dry Cell

Perhaps 80 per cent of the dry cells made and used at sub-stations are of the so-called No. 6 size, being cylindrical in form, with the zinc container six inches high and two and a half inches in diameter. The dimensions and construction of the zinc container seem to be uniform, but the thickness of the zinc varies from No. 7 to No. 11 zinc sheet gauge.

To those interested in the chemical action of the cell, the following description by a well-known manufacturer will be of interest:

"The anode makes contact with the electrolyte in the form of paper saturated with solutions of zinc and ammonium chlorides. Ideal conditions call for a corrosion of zinc only in amount equivalent to the current delivered to the external circuit; excess of corrosion above this amount is caused by local action, and one of the principal problems in dry-cell manufacture is to reduce local action to a minimum.

"Local action is caused only to a small extent by solder, although the latter is decidedly electro-negative to the zinc, but it is composed of two metals, lead and tin, both of which have high 'over-voltages,' which also entirely prevent current flowing to these metals at the expense of and under the E. M. F. set up by the zinc. Some experimental cells made from sheet zinc streaked with solder on the inner surfaces showed little, if any, abnormal deterioration due to local action, even after standing several months.

"On the other hand, copper or iron, but especially copper (which may occasionally find its way from the brass terminals into the cell), when coming in contact with zinc, will set up destructive local action.

"It occasionally happens that some of the filling material, the manganese oxide and carbon, gets into the paper lining and the zinc. This naturally gives rise to damaging galvanic couples. Also inequalities in the zinc itself may cause certain differences in potential.

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"BELL SYSTEM"

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"If we were to assume all inequalities of the zinc electrodes to be removed, we still have opportunities for local action due to inequalities in the electrode on the other side of the soaked paper. Non-uniformity in the mixture is detrimental. Some manufacturers place the carbon rod in direct contact with the saturated paper resting on the bottom of the cell, the mixture surrounding it. This gives rise to some difference of potential, and a measurement of this gave a value of 0.176 volts in each direction that current tends to flow from the carbon through the paper zinc, thence through paper to the manganese mixture and back to the carbon. To prevent this local action is probably the reason for the majority of cells now being made with the mixture interposed between all portions of the carbon surface and the paper.

"While the carbon rod is generally considered to be the cathode, the really active cathode surface must be considered to be of a more extended structure. The carbon rod is surrounded by a mass of material—carbon, graphite and manganese, possessing metallic conductivity, even though moistened by electrolyte. It would, therefore, be more accurate to consider the active cathode as that portion of the mixture just within the paper. While this may be the main cathode surface, it is not exclusively so, and the active surface progresses inward as the action of the cell goes on.

"The cathode is a compound one, consisting of an intimate mixture of conductive carbon and graphite in contact with manganese oxide, and the E. M. F. of the cell is the summation of the electrode potentials, 0.56 volt for the zinc (against Ostwald's standard electrode), and about 1 volt for the carbon-manganese oxide mixture, or a combined voltage of 1.56.

"While the cell delivers current to the external circuit, this voltage decreases, the rapidity depending upon the amount of current drawn. If it were not for the manganese dioxide, the drop of the voltage would be very rapid, and the value of the cell is, therefore, dependent largely upon the active manganese oxide or depolarizer. This manganese oxide is consumed. As commonly stated, it is reduced to Mn_2O_3, and in undergoing this change it becomes inactive both as a depolarizer and as a conductor.

"It is probable that MnO_2 possesses sufficient metallic conductivity to contribute something to the conductivity of the cell, and when changed to the lower oxide it loses this conductivity. It thus becomes inert and occupies valuable space. It is natural to assume that the MnO_2 in the other portions near the paper is the first to become reduced, the action progressing inward to a certain depth, this depending upon various factors, such as the intimacy of contact between the carbon and MnO_2, the purity, fineness and porosity of the latter, etc.

"If the MnO_2 possesses metallic conductivity and makes contact with conductive carbon, and both are moistened with electrolyte, there is a possibility that a certain amount of chemical action occurs, owing to the voltaic couple thus produced.

"A typical dry cell gives from 10 ampere hours (when short circuited and run down in one hour) to 30 ampere hours. The open circuit voltage is 1.5 or 1.6. A fair figure for the effective voltage during useful life is 1 volt for a discharge rate of 30 amp-hours, so that a fair energy rating is 30 watt-hours. During life the resistance of the dry cell increases, partly due to drying out, but more so on account of other reasons, like the partial reduction of MnO_2. Another reason is the accumulation on the surface between the paper and the zinc of non-

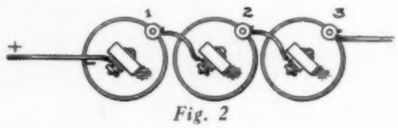

Fig. 2

soluble impurities of the zinc and the various basic salts and double salts resulting from the electrolytic corrosion.

"When a cell is first made up, the paper is saturated with a solution of zinc and ammonium chlorides. More zinc chloride is added as a result of the corrosion of the zinc. The increasing concentration of the $ZnCl_2$ in the presence of the ammonium chloride gives just the conditions which are needed for the production of various double chlorides, none of which are much less soluble than the single chlorides.

"These insoluble double chlorides occupy the pores and spaces in the paper, crowding out the electrolyte and increasing the resistance. If ammonia is liberated, it may react with the $ZnCl_2$ to form a precipitate of ZnOH, which likewise clogs the cell, unless sufficient ammonia is present to re-dissolve the precipitate. That this clogging action occurs at the paper and proceeds inward towards the carbon rod is evident, since in taking apart a run-down cell there is usually found a hard crust of ⅛ inch or more in thickness just inside the paper.

"It is no doubt true that improvement in dry cell construction must come through reducing this accumulation of insoluble non-conductive material. It may be suggested that this precipitation, due to double chlorides, might be delayed by using only NH_4C in the electrolyte to begin with, and, in fact, a somewhat greater ampere hour output can be obtained in this way. But it involves the more serious disadvantage of shortening the life of the cell on open circuit. The presence of $ZnCl_2$ in the electrolyte decreases in marked degree the local action.

"Although marked improvements have been realized, there is still need of and a possibility for improvements. A new method of rating dry cells by energy output should also be adopted. This can only be done after determining and generally adopting the standard methods for conducting tests."

Some Hints on Care and Installation of Dry Cells

Dry cells should always be placed in a vertical position and should not be located in very damp or very dry places. Always put date of installation on each cell and make a record in your subscribers' ledger of date installed or changed. In this way you can check up on subscribers who are using too much battery. When subscribers insist on "listening in" on a party line, a lock called a "battery saver" may be attached to the receiver hook. By using this battery saver, the subscriber is enabled to hear what is going on on the line, but the transmitter and battery are cut out until the subscriber presses a small lever, which releases the receiver hook and permits him to carry on a conversation.

Never put in a new cell of battery with a worn-out cell. It is a waste of time and money. Discarded sub-station cells may frequently be used to good advantage on a switch-board night alarm or on door bells. The average life of dry cells under normal conditions is about ten months. Care should be taken that connecting wires do not short circuit individual cells when several dry cells are connected in series. Short pieces of insulated wire arranged as shown in Fig. 2 will prevent trouble.

TYPES OF WET BATTERIES

As previously stated, dry cells are not suited for closed circuit work such as operators' transmitters, etc., and for this service, where storage battery service is not available, it is recommended that one of the following types be used: Gravity, Edison-Lalande, now known as the Edison Primary Cell, or Gordon. As a general rule the gravity cell renders the best service and is more economical, while the low resistance of the other types (.05 of an ohm) is a strong recommendation for their use. The gravity cell will not work on an open circuit, while the other two types work well on both open and closed circuits. It is important when using

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the latter types that the operator's circuit be so arranged as to be open when not in use. This can be done in two ways—by the addition of an extra spring on the listening keys or by the withdrawal of the operator's plug attached to the head receiver, the former method preferred. Special emphasis is given to this because of its importance in the small exchange. The voltage of dry cells falls off very much more rapidly than do the above types. Various efforts have been made to find a better closed circuit battery than the gravity type, but, after all, if this type is used with any degree of consideration and care, it will give perfect service for a long time.

It must be remembered that a local battery operator's transmitter requires three volts to do good work. Hence, if gravity battery is used, three cells are required and four of Edison or Gordon. Best results are obtained in all wet batteries when distilled water is used, or if this is not available, rain water. Impurities in the water usually cause frothing if any organic matter likely to produce this effect is present. If neither distilled or rain water is available, then the water should be boiled for about fifteen minutes, stirring in a small amount of soda, then allowing the water to stand for twelve or fourteen hours until a deposit settles, when the water should be drained off, eliminating the deposit. The writer has found this very convenient, especially where alkali is present in the water. If properly cared for, the above types of battery will give good service on operators' sets in small magneto exchanges for approximately two months with an average use of about twelve hours per day.

The location of batteries is very important. They should be as near the apparatus served as possible in a light, dry place; otherwise local action may take place, producing creeping salts, which partially shunts the transmitter circuit. They should be inspected at regular intervals. The points to look out for in such inspections are creeping of the solution, discolorization, pitting and eating away of the zinc, exhaustion or evaporation of the solution. The internal resistance of these batteries is about as follows: Gravity, 2 to 6 ohms; Fuller, .023 to 0.5 ohms; Edison, .075 ohms. A well designed local battery transmitter should operate well with a consumption of not more than .2 ampere.

Le Clanche Cell

One of the early forms of wet cells, known as the Le Clanche, was brought out in the year 1868 by Le Clanche, a Frenchman. It consisted of a hard carbon plate or rod, surrounded by lump carbon or coke mixed with manganese dioxide. The carbon and manganese were contained in a porous cup or burlap sack and surrounded by the electrolyte, which consisted of a solution of sal ammoniac and water. The zinc electrode consisted of a rod of zinc placed in a vertical position in the electrolyte. The manganese dioxide acted as a depolarizer, but the depolarization action was slow and hence this type of battery was good only for short intervals. The Le Clanche cell had a voltage of approximately one and a half volts. There are still a number of these cells in use, but the dry cell has practically superseded it.

The Gravity Cell

This type of cell is still in use and should be much more popular in the small telephone exchange, as it is most dependable for use on operators' transmitters where it is not possible to use accumulators. Much of the poor transmission noticeable in small exchanges when talking with the central office is due to the persistent use of dry cells on closed circuit work by negligent managers. Where the dry cell is used for operators' transmitters it is imperative that a battery cut-off spring be used on the listening keys so that the battery is in use only when the operator has her key open and in the answering position. Even then carelessness on the part of operators leaving their keys open or the keys being pushed accidentally into the answering position may cause undue drain on the battery. It is very important that the operators' transmission be uniform as possible, and this can only be done by the use of accumulators (storage battery) or, where this is not possible or practicable, by the use of the gravity cell. Another leaf out of the writer's experience in handling small magneto exchanges is that it is not possible to use accumulators or storage battery to advantage where electric light is not available for charging purposes. Hence, in such a case the only answer is the gravity cell. An effort was made some years ago to use portable accumulators for this purpose and have them charged at some charging station, but this was found not only inconvenient but expensive.

The gravity cell consists of a large cylindrical glass jar. In the bottom of this jar is placed a sheet copper electrode, made by standing on edge several sheets of copper riveted in the center. The ends are bent out in the form of a star, thus exposing to the electrolyte the largest possible surface. To this copper electrode is attached an insulated wire about No. 18 gauge, the insulated wire extending about six inches beyond the top of the jar, thus forming one terminal of the cell. The copper electrode is then surrounded by crystals of copper sulphate or blue vitriol, the whole space between the leaves of the copper electrode being filled up almost to the top. Hung on the edge at the top of the jar is the zinc electrode in the form of a heavy zinc casting, shaped so that it has a number of radiating arms resembling a crow's foot, thus exposing to the electrolyte the largest possible surface. It will be noticed that there are two different colored solutions in the jar, the one at the bottom being of a deep blue color, while the one at the top has a whitish color. The blue liquid is a solution of copper sulphate, while that at the top is a solution of zinc sulphate. The difference in weight or specific gravity of the electrolyte keeps the two solutions from mixing and shows a distinct line of separation between them. In service every effort should be made to keep this line about the middle of the two electrodes. The cell has a voltage of approximately 1 volt and is reasonably uniform when properly cared for. Since the voltage is low, three cells are necessary for the operator's set. They should be located as close to the operator's transmitter as possible, but if this cannot be done, large insulated copper wire should be used in making the connection. The only excuse for not using this type of cell in small magneto exchanges is either ignorance or laziness on the part of the attendant, and it is unfair to sacrifice transmission for the convenience of someone who is paid for doing this work.

Suggestions for Setting Up the Gravity Cell

Mr. R. H. Perry, of Aberdeen, S. D., gives the following suggestions for setting up this type of battery, which the writer has found to be very useful and practical:

"First, wash the three or more glass jars carefully, then thoroughly dry them. To insure perfect results, add about a teaspoonful of muriatic acid to the water. Then dry carefully by the fire or in the sunshine—be sure that they are perfectly dry.

"Procure a pint can of black paint (preferably mineral preservative) and paint on the inside and outside and down one inch three distinctive different coats, letting each one dry thoroughly before applying the next. Install the copper in the bottom of the cell carefully, care being taken to turn the ends of the copper under so as to afford an anchorage. Put the copper sulphate in the cell, using a small paper funnel. Do not let any of it touch the upper portion of the cell. Next pour in the water. The writer has

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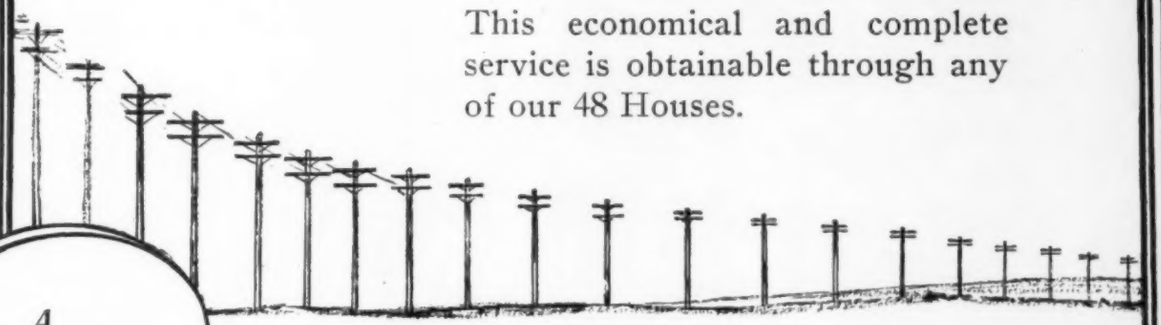

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found by careful experiment that if the water is distilled or rain water is used, sulphating will be retarded many weeks. Care must be taken, not to allow the solution to touch any portion of the cell except the inside, and only up to within the block line. If dry hands and a small rubber hose are used there will be no reason why the cell should be moistened. Before installing the zinc crow-foot, paint the hook with three coats of the mineral paint and let it dry on the jar. When the cell is complete, short circuit the series for twenty-four hours and excellent results will follow. Oil, acid or glass covers, or any other unclean method, can be dispensed with. The writer has found that if the copper sulphate is ground to a fine powder and put into the cell with a paper funnel twice a week on regular days, and water added at corresponding intervals, the battery will give fine results. In fact, these batteries should be charted and given the same care as an expensive storage battery. They are just as vital an item in the revenue earning as any other plant factor. Watch the cells, keep them clean and at least give them a fair chance. They will gladly pay their bill."

The above detailed explanation shows that at least one telephone man appreciates the splendid, reliable and economical service rendered by this excellent battery.

Maintenance of Gravity Cells

In testing the electrolyte of the gravity battery a special hydrometer may be used. When it reads less than 15 degrees, add more blue vitriol (as this shows too little sulphate of zinc). Thirty degrees and over shows too much sulphate of zinc, and in this case the top liquid should be drawn off and substituted with clear water. The normal specific gravity of a gravity cell in good order is 25 degrees.

In hot weather the water needs to be changed oftener than in cold weather. The batteries should be kept in a cool place in summer and moderately warm in winter. Batteries of any kind are more or less sensitive to heat and cold. Every one who has the care of gravity batteries should have a syringe for regulating the liquid of the batteries. It could also be used for drawing off the water before fresh water is added. Experience shows us that changing the water once a month is usually sufficient to insure good results.

The zinc element should be renewed as soon as the transmission over the longest exchange lines begins to show up poorly and examination of the zinc element shows that a large portion of the zinc metal is gone. It should be cleaned from time to time of the copper and salts which gather on it, and as soon as about 80 per cent of the crow-foot has been consumed (or eaten away) it should be discarded and a new one used. When the copper element becomes so heavy with metallic copper that there is no longer sufficient room for the copper sulphate in the bottom of the jar, it should be replaced and the old one sold as junk.

As the action in the gravity cell progresses the solution in the top of the jar becomes more dense and the internal resistance also increases until a

Fig. 4

point is reached when but little current will flow. As previously stated, drawing off the top solution and renewing with water improves this condition. Do not let the crystals of blue vitriol entirely disappear from the bottom of the jar, but put more in from time to time. The presence of salts on the side of a jar is a sure sign that the zinc sulphate is too dense. Once a battery has been connected up, it should not be left on open circuit for any length of time, as this is a closed circuit cell.

After setting up or renewing your batteries, be careful not to use soap in washing your hands, as the blue vitriol forms an insoluble compound with soap. The proper method is to grease your hands thoroughly with oil or vaseline, rubbing it in well, then wipe off as much of the oil as possible and wash with the soap. A pair of rubber gloves are very convenient if you can afford them.

In order to show up the blue line to good effect it is suggested that the shelf and the wall behind the cells be painted with black asphaltum paint. A few minutes spent each day in looking over these batteries will cause them to present a nice appearance at a low battery expense. An excellent type of rack for mounting several sets of gravity cells is shown in Fig. 3.

The Edison Primary Cell

The Edison type of cell has been very popular in the telephone industry for operating the vibrator magnets of one type of pole changer used in small exchanges to supply ringing current. Again the writer has found that laziness or ignorance plays its part in that many managers insist on using dry cells for this purpose. This is a grievous mistake, as dry cells are not at all suited for this purpose. The Edison cell, Fig. 4, consists of a porcelain jar with a removable porcelain top. Inside is a plate of copper dioxide with a zinc plate on each side of and parallel to it. The three plates are fastened to the

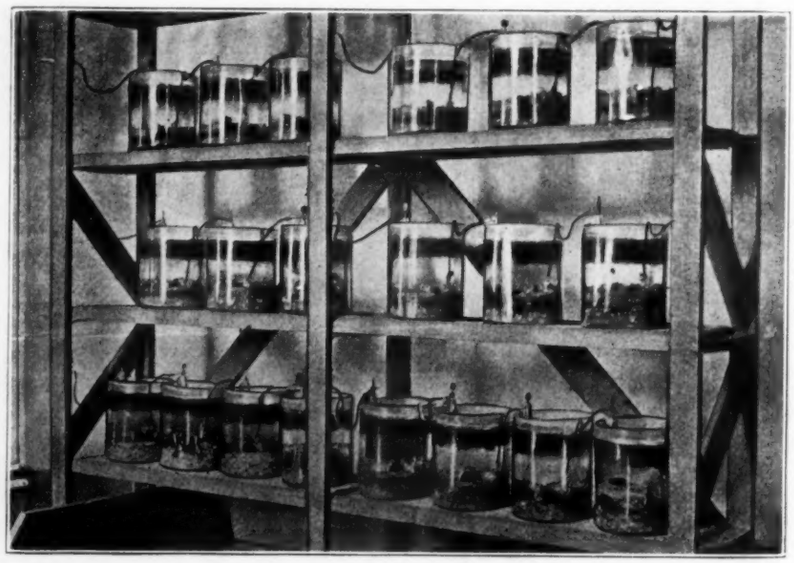

Fig. 3

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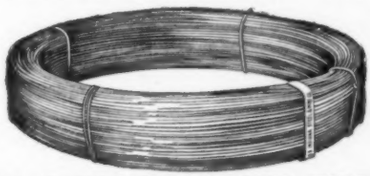

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cover, and when this is in position they are suspended in a solution of caustic soda. In this type of cell it is not necessary to short-circuit the cell before putting into service, as it is ready for use as soon as it is made up. This cell has a voltage of from .7 to .9 volts, is adapted to many different classes of service and gives very satisfactory service when a heavy current is necessary.

The Fuller Cell

Prior to the introduction of common battery telephone systems, which employ storage batteries at the central office to furnish current to the subscribers' stations, this type of battery was extensively used for long distance work. At the present time its use in the telephone field is very limited, being used in isolated long distance pay stations or on test boards in small exchanges, where electric current cannot be obtained, for the purpose of testing lines in case of trouble, and at private branch exchanges having no central office battery supply. The zinc electrode of the Fuller cell consists of a heavy zinc block moulded in the form of a cone. From the top of this cone extends a copper wire beyond the top of the cell, and forms one terminal of same. This cone is placed in the bottom of a porous earthenware cup, which is surrounded by an electrolyte consisting of sodium bichromate (6 oz.), sulphuric acid (17 oz.) and water (56 oz.). Sometimes a few globules of mercury are dropped into this porous cup to amalgamate the zinc unless the same has been previously amalgamated. The carbon electrode consists of one or more carbon plates suspended in the electrolyte outside of the porous cup. It is very important that the zinc be amalgamated; otherwise the efficiency of the cell is decreased. The cup is then filled with a solution of salt and water. It is customary to provide a top for this type of battery. The voltage of this type of cell is approximately 2.1 volts.

There are many other types of wet cells, but the above described cells are the principal ones used in telephone work, and as previously stated, their use is becoming less and less every day on account of the introduction of the dry cell for storage batteries.

Improving Ft. Wayne Plant

Installation of underground cable feeders for the east part of Fort Wayne, Ind., has been started by the Home Telephone & Telegraph Co. The work, including underground conduit and cable and the aerial cable distribution system conecting with the underground, will cost considerably over $150,000.

Men & Money 2 Big Problems

State Chiefs in Semi-Annual Meet

Chicago, Ill. — Smaller telephone companies are coming into their own, as a result of state association work. The semi-annual conference of state association executives held at Chicago in June marked a further advance in the association efforts for the smaller Independent companies.

Men and money, the two problems of the Independent industry, as viewed by President MacKinnon of the National association, occupied the center of attention. Results of the Texas Independent association's financing plan were presented by President Still of that association. Mr. Still told that about $40,000 has been loaned since the Texas convention in March. These loans will be turned over to the loan association which is being formed on the "building and loan" plan. One property, as a result of a $25,000 loan, had been able to continue operating under its present ownership and make needed improvements. To pay off a loan, under the Texas plan, 90 monthly payments are required. Each payment is $15.83 per $1,000 borrowed, which includes interest and payment on the principal. The first month the interest is $8.33 and the payment on principal, $7.50. The proportions change so that the last payment is 14 cents for interest and $15.69 for principal.

Interest charges are 10%, of which 2% goes as administrative expense, and 8% to the investor. It was suggested that the trust deeds be standardized so telephone bonds will be uniform, and a general market created.

Employees' Benefit Plans

Employees' benefit plans that retain and attract employees were considered at length. For the small exchange it was said that a plan which would allow a good man in charge of the plant to purchase an interest in it, was the most feasible. The Bell compensation insurance plan, which is more liberal than the compensation laws, was cited as a guide for Independent endeavor. The matter was found to be one that the national Independent association could not handle because of the wide variation in state laws. The possibility of some insurance company making a special rate for compensation insurance to Independent companies, was considered. This rate, of course, to depend upon the acceptance of the insurance company's proposition by a considerable number of Independent companies.

Busy on Legislation

During the roll call, when each state executive present was asked to highlight activities in his territory, it was found that the state associations all have been active in promoting favorable legislation and working against unfair law making. Operators' education, and the work done by the Iowa association in this field, was the feature of the remarks made by F. M. Boardman, president of the Iowa association. Ohio's efforts to care for its smaller companies were described. In the questionnaire sent out by the Ohio association, there is a question asking if the plant receiving the questionnaire is for sale. The idea being that the association may help in keeping the plant in the Independent ranks.

Inductive inference legislative matters also came up for discussion, and mention was made of the Minnesota association's efforts with the legislature on this matter.

Co-ordinating the state convention dates so the exhibitors would be able to make all the meetings conveniently with the best displays at their command, provoked considerable discussion. Representatives of several of the leading manufacturers and the association executives threshed out the matter to the conclusion that an early announcement of tentative dates of state association meetings would allow final arrangement of a thoroughly satisfactory schedule. Mention was made of the troubles the exhibitors have with hotels in getting their exhibits set up right, while the hotels complain of damage done to their premises.

Bell to Handle Red Fork Toll

Oklahoma City, Okla.—In the application of the Red Fork Telephone Co. for an order commanding the Southwestern Bell Telephone Co. to connect its line with the exchange of the Red Fork Co., the commission authorizes such connection and establishes a rate of 10 cents per call for "person-to-person" calls and 5 cents per call for service designated as "two-number" service. The order prescribes a division of proceeds, and further provides that subscribers on rural line between Tulsa and Red Fork may be connected with either city's exchange, but not with both. This case has been a hard fought contest before the commission.

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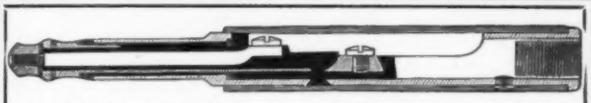

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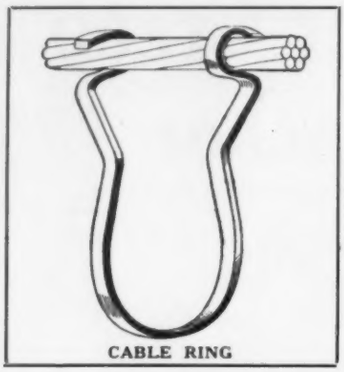

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McKay's achievements as a consulting engineer specializing in telephone engineering, valuation and rate problems, have identified him as one of the foremost authorities in this line. Since his graduation from Cornell in 1906, wth the degree of Mechancal Engineer, Mr. McKay has been closely connected with the telephone industry. His telephone career began with the New York Telephone Co. in 1906.

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